

SCIENCE

[Entered at the Post-Office of New York, N. Y., as Second-Class Matter.]

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

SEVENTH YEAR.
VOL. XIII. NO. 329.

NEW YORK, MAY 24, 1889.

SINGLE COPIES, TEN CENTS.
\$3.50 PER YEAR, IN ADVANCE.

THE DAFT ELECTRIC ROAD IN CINCINNATI.

IN response to the request for data as to the electric road known as the "Kerper Walnut Hills Electric Road," now being operated by the Daft system of double-trolley underneath contact, it may be said that it is not generally known that this is the only system of double-trolley underneath contact in successful commercial operation in the United States to-day. It is not intended to imply that there had not been attempts made in this direction; but it has generally been claimed, that, with parallel wires, a double underneath

as presenting features which would recommend itself to the general public. Some difficulty was met with in the operation of this road at first, owing to the peculiar demands made upon it at the McMillan Street and Gilbert Avenue junction. Here concentrates an enormous traffic from the Walnut Hills district and the outlying suburbs; in fact, the narrow artery at the head of Gilbert Avenue was practically the only outlet for the vast traffic into and out of Cincinnati.

To Mr. George B. Kerper great credit is due for the solving of what was a most vexatious problem. By him a further extension



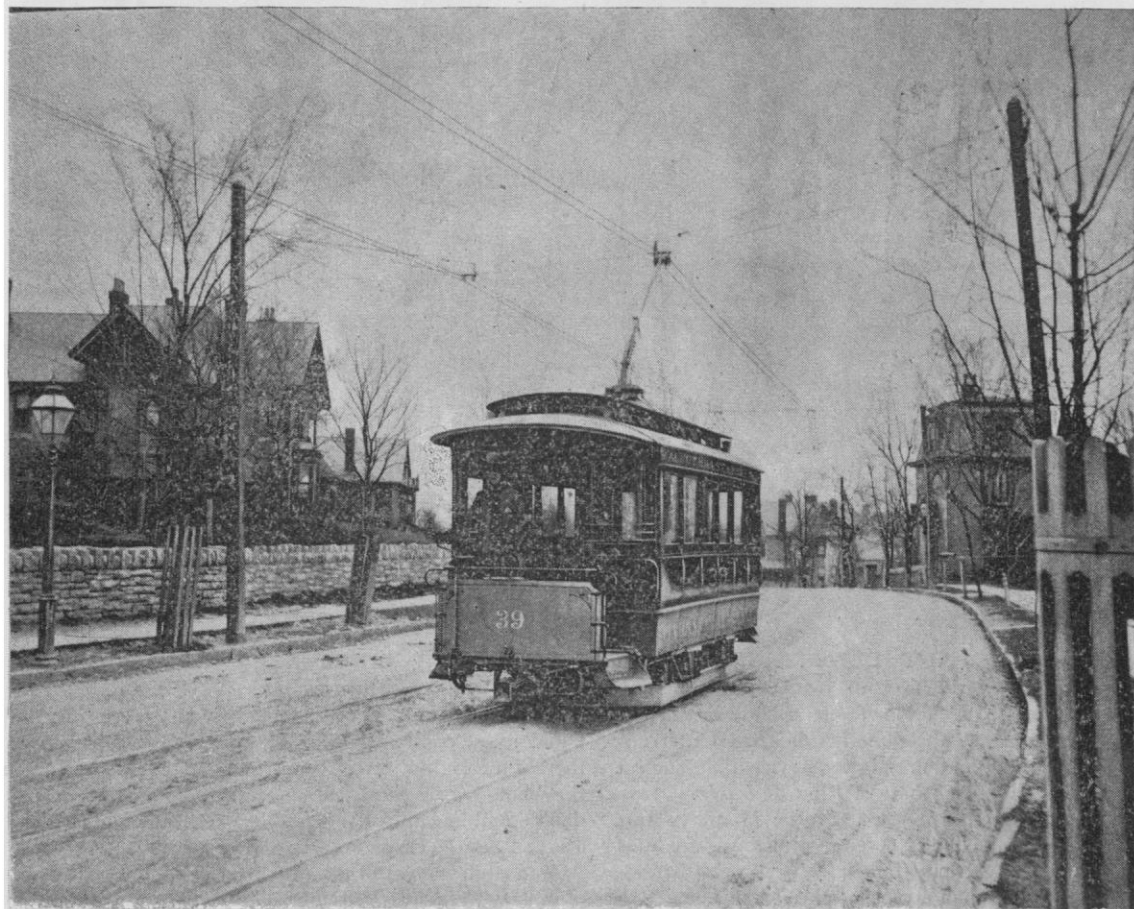
DAFT ELECTRIC ROAD, WALNUT HILLS, CINCINNATI.

contact was impracticable. Not that such operation was not desirable, because the obtainment of absolute freedom from interruption to telegraphic, telephonic, and fire-alarm service that such a system gave, could not well be any thing else but desirable.

To Mr. George B. Kerper, the president of the Mount Adams and Eden Park Inclined and Gilbert Avenue Railways, credit is due for the introduction of electricity for the operation of street-railways in Cincinnati. More than a year ago he foresaw that this new force was moving rapidly to the front in its adaptability to street-car propulsion. Casting about, he selected the Daft system

of the road into Mount Adams and Eden Park Cut was determined upon, a new contract was made, and in thirty days from the date thereof the Daft Electric Company had completely reconstructed the whole line, refurnished its entire equipment, substituting the double underneath for the double overhead contact, and, without a break, set the car in commercial operation.

As a confirmation of the judgment of Mr. Kerper as to the value of the Daft system, the remarkable manner in which this double underneath contact trolley furnished by the Daft Company fulfils its purpose, the symmetrical and enduring character of its struc-



DAFT ELECTRIC ROAD, CINCINNATI, ROUNDING CURVES.

ture, the high speed of the cars (going much faster than the cables), the easy motion of the car, the freedom from jerking and lack of danger elements, fully attest the wisdom displayed.

The cars as now equipped are able to tow additional cars, their equipment being of sufficient power. They have fully demonstrated their efficiency in many instances; in one case having pushed the Avondale cars up the $7\frac{1}{2}$ -per-cent May Street grade when the horses were stalled from overloading, and in another pushing the heavy cable-trains back upon the track at a recent occurrence.

The performance of regular commercial service by these Daft motor cars over a road upon which there are not over six hundred feet of straightaway track (in one mile there being six cross-overs, eight curves, and grades as high as $7\frac{1}{2}$ per cent, travelling for a portion of the road over a regular cable-line), and the ease with which they are able to run away from the cable-cars, mounting grades continuously wet by street-sprinkling carts, demonstrate that the Daft system in Cincinnati has scored a complete success, and justifies the confidence reposed in it by the managers of the street-railway company.

Praises for the manner of its construction, its equipment, and its operation, are heard everywhere. One of the most remarkable features about this line is the double underneath contact trolley. It requires no attention from driver or conductor: in fact, were it not for the ordinances requiring a conductor to each car, his services would be wholly unnecessary. The trolley moves with the same ease as the car upon the track, and its liability to leave the wires is very much less. Its construction is such that it regulates itself to all the various dips, angles, curves, etc., with the greatest facility.

Another important feature of the Daft system is its great economy.

The power is taken from the engine which drives the Gilbert Avenue cable, and so some fluctuation of speed in the generator results, but not sufficient to interfere in any way with the successful operation of the electric road.

Half-hourly records are kept of voltmeter and ammeter readings, the dynamo speed, and the temperature of the engine-room. From these it can readily be seen when the car is ascending grades, when descending, when at grade, when with more than an ordinary load, etc. At the dynamo station it is practicable to tell at any hour of the day the relative position of the cars to the line. Power is only absorbed by the motors upon the car to meet the requirements made upon it by their several loads. Of course, under such circumstances, when there is no demand for power, there can be no expenditure, and the result is the highest economy. It is usual with street-railway people to base the success of any system, whether it be by horses, by cable, or by electricity, upon the dollar-and-cents basis. In this respect the Daft system recommends itself to thoughtful business-men.

INSECTICIDES AND THEIR APPLICATION.

As the season of the annual warfare between vegetable life and its insect enemies has come round once more, our readers will probably find interesting a report on insecticides recently published by the Ohio Agricultural Experiment Station. The director of the station states that insecticides, or the substances used for destroying insects, may broadly be divided into two classes: (1) internal poisons, or those which take effect by being eaten along with the ordinary food of the insect; and (2) external irritants, or those which act from the outside, closing the breathing-pores, or causing death by irritation of the skin. Besides these, however, various other substances are used in preventing insect-attack, keeping the pests away because of offensive odors, or acting simply as mechanical barriers.

The most important insecticides are the poisons. Of these the most popular are the various combinations of arsenic, known as "Paris green," "London purple," "slug-shot," and a large number of patent insecticides sold under various names.

Paris green is a chemical combination of arsenic and copper, called arseniate of copper. It contains about fifty-five or sixty per cent of arsenic, and retails at about thirty cents per pound. It is

practically insoluble in water, and may be applied either dry or wet. In the former case it should be well mixed with some fine powder as a diluent: plaster, air-slacked lime, flour, road-dust, and finely sifted wood-ashes, all answer the purpose fairly well, though lime or plaster is usually preferable. The proportion of poison to diluent varies greatly with different users: one part poison, to fifty, and even one hundred, of diluent, will usually be effective, if the mixing be thoroughly done. In the wet mixture for fruit and shade trees, use one pound poison to 150 gallons water, and keep well stirred. The chief objection to Paris green is that it is so heavy that it settles quickly to the bottom of the vessel,—very much more quickly than London purple. It is also more expensive.

London purple is a by-product in the manufacture of aniline dyes, produced by Hemingway's London Purple Company of London, England. It contains nearly the same percentage of arsenic as Paris green, and is much cheaper, retailing at about fifteen cents per pound. It is a finer powder than the green, and consequently remains in suspension much longer. It may be used in the same way,—as a powder or in water,—and the proportions given above answer very well for it.

White arsenic is sometimes recommended as an insecticide, but fortunately is rarely used. It is much more dangerous to have around than either of the above highly colored compounds, and in practice is very liable to burn the foliage to which it is applied.

The principal substances used for killing insects, by contact, are the following:—

Hellebore is a powder made of the roots of a plant called white hellebore (*Veratrum album*). It is a vegetable poison, but much less dangerous than the mineral arsenical poison, and kills both by contact and by being eaten. It may be applied as a dry powder or in water (an ounce to three gallons). It retails at about twenty-five cents per pound, and is especially excellent for destroying the imported currant-worm.

Pyrethrum is an insecticide of recent introduction, made from the powdered flowers of plants of the genus *Pyrethrum*. There are three principal brands upon the market, known as "Persian insect-powder," "Dalmatian insect-powder," and "buhach," the last being a California product. The greatest obstacle to the use of pyrethrum has been the difficulty of obtaining the pure, fresh article. If exposed to the air, the poisonous principle volatilizes, and the powder is worthless: hence dealers should purchase a fresh supply each season, and should keep it in air-tight vessels. Pyrethrum is used mainly either as a dry powder or in water (one ounce to three gallons), but may also be used in the form of a tea or a decoction, a fume, or an alcoholic extract diluted. For use as a dry powder, it may advantageously be diluted with six or eight parts of flour. It is especially excellent for clearing rooms of flies and mosquitoes, and for killing the common cabbage-worms. It is practically harmless to man and the higher animals.

Kerosene emulsion is made by adding two parts of kerosene to one part of a solution made by dissolving half a pound of hard soap in one gallon of boiling water, and churning the mixture through a force-pump with a rather small nozzle until the whole forms a creamy mass, which will thicken into a jelly-like substance on cooling. The soap solution should be hot when the kerosene is added, but of course must not be near a fire. The emulsion thus made is to be diluted, before using, with nine parts cold water. This substance destroys a large number of insects, such as the chinch-bug, cabbage-worm, and white grub, and is a comparatively cheap and effective insecticide. Besides its use as an emulsion, kerosene alone is frequently used for various pests. It is especially valuable in destroying vermin on domestic animals and in hen-houses.

Carbolic acid, especially in its crude state, is valuable for various insecticidal purposes. An excellent wash for preventing the injuries of several tree-borers is made by mixing one quart soft soap, or about a pound of hard soap, with two gallons water, heating to boiling, and then adding a pint of crude carbolic acid. Carbolic-acid soaps are largely used for destroying vermin on domestic animals.

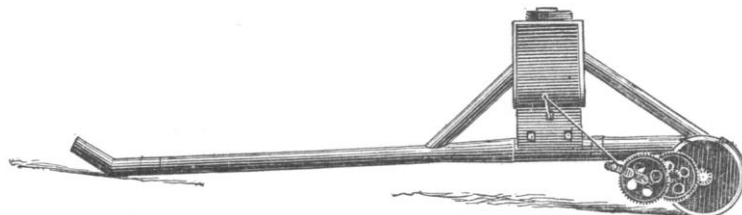
Tobacco is a very valuable insecticide for use against vermin on domestic animals and green-house pests. It may be used in the form of a decoction, a smoke, or dry. The refuse stems from the

cigar-factories are generally easy to obtain, and, if fresh, are effective in destroying the pests mentioned.

Bisulphide of carbon is a volatile substance used for destroying grain insects, ants, the grape phylloxera, and other insects which may be reached by a vapor. It is inflammable, and should never be used in the vicinity of a fire. Benzine is another volatile substance, used for much the same purposes as the last. Gasoline may also be mentioned in the same connection.

Coal-tar has been largely used in the West for destroying Rocky Mountain locusts, being placed on flat pans, on which the insects jump and are caught. It is also employed to prevent the migra-

opportunities; but it is absolutely necessary that the first attacks of the ravenous little creatures be promptly met. Do not delay a single day, for they increase in numbers with marvellous rapidity; and one day is sufficient for millions of eggs to be laid, to reproduce in a short time larger hosts, even should we be successful enough to destroy the original advance guard. Promptness in this will save one-half the trouble and expense later on. In applying insecticides, it should be borne in mind that "a little is as good as a feast." It is not necessary to drown the insects with solutions, or to bury them with powder, to kill them, — the least particle of poison is sufficient to do its deadly work, — but it is necessary that



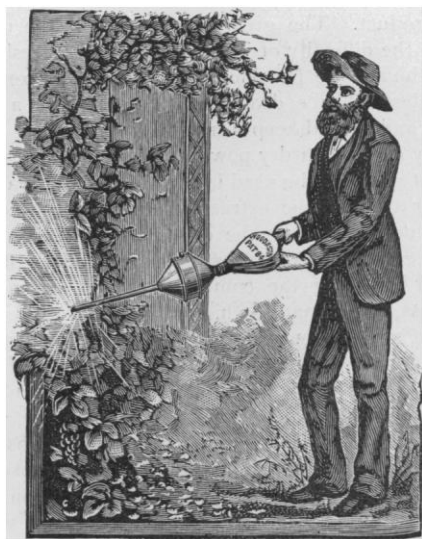
LEGGETT'S POWDER-GUN.

tions of the chinch-bug. A shallow V-shaped channel is made with the corner of a hoe along the borders of the field to be protected, and tar poured in. So long as the tar does not dry out, the immature chinch-bugs cannot cross it.

Lime and plaster are excellent for use in preventing the depredations of certain insects. Plaster may be dusted on melon and other vines to drive off flea-beetles; and fresh-slacked lime may be dusted or sprayed (a peck to fifty gallons of water) on grapes, peaches, etc., to prevent rose-beetle injuries. Gas-lime is sometimes recommended as an insecticide, but seems to be little used in America. It is valuable as a fertilizer, and can be obtained at little cost.

"the least particle" and the insect come in contact. It is much better to reach every portion of the plant or tree, underneath as well as above, with a fine spray of fluid or a slight dusting of powder, than to apply liberally in some parts and carelessly overlook others, as is the too general custom. To fight insects effectually, it must be done thoroughly, and every inch must be covered. Besides, there is much less danger of burning or injuring the leaves and fruit by light applications.

The recently improved implements for applying powders or fluids are great economizers, covering larger surfaces with less material, doing it with greater speed, and reducing the danger of injury to plants to a minimum. Among them we will mention



DOUBLE-CONE POWDER-BELLOWS.

Soluble phenyl and paraffine-oil are two English insecticides frequently recommended for trial here, but which are as yet little used. For the following facts concerning the newer inventions for the application of insecticides we are indebted to Peter Henderson & Co., seedsmen of this city.

The enormous damage done by insects to our fruits, vegetables, grain, etc., is almost beyond belief, — amounting, it is claimed by competent authorities, to from \$200,000,000 to \$250,000,000 per annum in the United States alone, — and their ravages are steadily increasing. Fortunately the extensive experiments in insecticides and implements for applying them enable us to fight them so well that the damage done is scarcely felt when the most is made of our



VAPORIZING-BELLOWS.

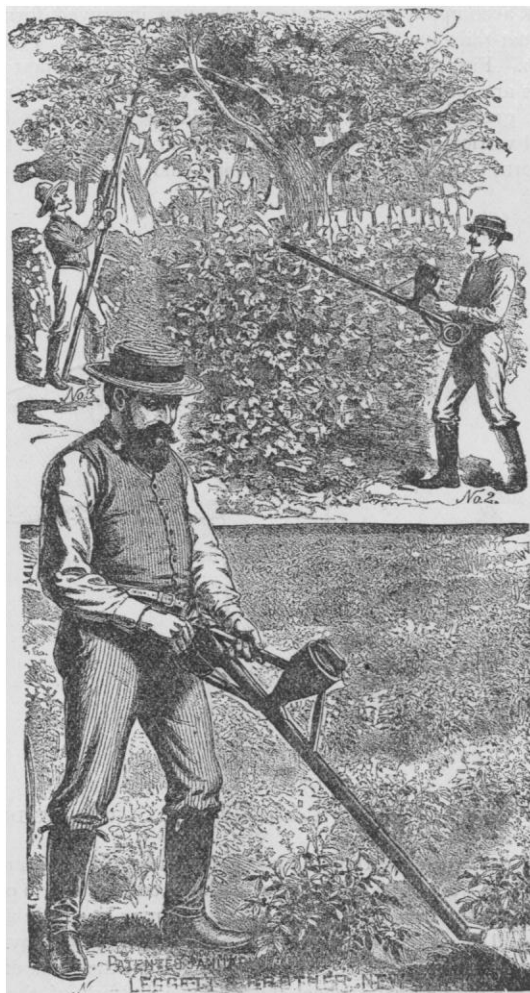
Leggett's powder-gun, in which a rapidly revolving fan-wheel blows the powder through a long tin tube with such force that it is widely and lightly distributed over a large surface. Sectional tubes can be added, so the powder will go up into the tallest fruit-trees; and, as the under side of the leaves are reached as well as above, it is an exceedingly effectual implement. A short curved tube comes with it for applying powders to low-growing plants, by which the under side of the foliage is reached as well. The supply of powder can be regulated to such a nicety, that Mr. Leggett claims he can make half a pound of London purple cover an acre. Woodason's improved double-cone bellows is also worthy of special mention. It is impossible to clog it, as a series of perforated tubes

run through the powder-chamber, keeping the powder constantly stirred up; and, no matter in what position it is held, the same regular supply is blown out. A detachable spout enables the operator to blow up under the foliage of vines and potatoes without stooping and getting into tiresome positions.

For applying fluids, there is an ingenious device nearly ready to be put on the market, which looks not unlike a Babcock fire-extinguisher. It is carried on the back of the operator, which enables him to carry twice the quantity of fluid with greater ease than by the old method, with a bucket. But its great merit lies in the fact that the fluid is forced out by compressed air, through two short pieces of hose, which are held in each hand, enabling two rows to be easily covered at a fair walk. The fluid can be applied in the form of mist, spray, or stream, at will; and, when the air has been exhausted, a few movements of the small pump-handle are sufficient to recharge it. Vaporizing-bellows are also exceedingly valuable for applying solutions of alcohol, kerosene, fir-tree oil, and other insecticide solutions of like character, which are such thorough insect-exterminators, but so dangerous to the plant when carelessly applied by syringe or sprinkler. With the vaporizing-bellows, these strong fluids can be applied almost like vapor, and the insects are killed without danger to the plants. Some of the newer spraying-pumps for orchard and field use are a step in the right direction. A "return discharge" is added, the mouth of which can be placed near the suction-pipe at the bottom of the barrel; and it keeps the solution thoroughly churned and mixed, as no stirring with a stick can do. When kerosene emulsion, fir-tree oil, or other oily insecticide is used, which rises naturally to the surface, the mouth of the return discharge should be placed on or over the surface. Kerosene, when intelligently applied, is a valuable remedy. We know of its being used, to the exclusion of all other insecticides, in greenhouses containing the rarest plants; and brighter, cleaner, healthier stock we never saw. But it is used with discretion. On woody and hardier plants, such as camellias, palms, azaleas, etc., one pint of kerosene to four gallons of water is used; and for delicate-foliaged plants, from one-third to one-half less kerosene is used. When applying the solution, one man is constantly drawing and forcing the fluid back through a syringe into the bucket, while another fills his syringe with the thoroughly churned solution, and applies it to the plants: therefore these return-discharge pumps are gotten up to work on the same correct principle as that of the two men just described, for applying not only kerosene, but London purple and Paris green poisoned waters as well; for these two powders are not soluble, and soon settle to the bottom, leaving the surface water too weak, and that at the bottom so strong that the foliage is likely to be injured.

Insect-killing powders are much more efficacious when blown into the plant than when dusted on, as is the usual practice. When blown on with a bellows or other implement, the powder separates into clouds of impalpable dust; and the force causes it to penetrate the innermost crevices, destroying the hidden insects and larvæ by filling their breathing-pores (which, as all know, are situated in rows on each side of their bodies), thus suffocating them. This is the main reason why non-poisonous powders are frequently as effectual as poisonous. We know of a firm of large cabbage-growers in Florida who have saved their crops for several years, while their neighbors' have been almost a total loss, simply by blowing Persian insect-powder of *high grade* into each plant with a finely-distributing bellows. Their men go over the fields occasionally, not stopping to see whether a cabbage is affected or not, and simply puff a small quantity of powder into each in a rapid, business-like manner; and the result speaks for itself. You will notice that we emphasize "high grade" in connection with the Persian powder. We do so, because the cheap grades are almost worthless. The "high grade infallible" is produced from the half-opened flowers and buds of *Pyrethrum roseum* or its hybrids, that from the collected wild flowers being superior to the cultivated; while the cheaper grade is made from opened flowers gathered later in the season, with frequently the flower-stems ground in; and lots of useless cheap stuff is sold which is made from the stalks and stems of the plant, ground and colored so finely that to the uninitiated it appears better than the superior grades. The insect-destroying properties of the Persian powder depend largely on the

fineness to which it is ground, enabling it to penetrate the breathing-pores of the insect, and on its resinous properties causing it to adhere and suffocate them. This resinous property is easily injured by exposure, and generally entirely destroyed by dampness. Dalmatian powder and buhach are made from the same family, grown in other sections of the world, the former being from Dalmatia, and the latter from California. All are equally good if the flowers are gathered at the proper stage and thoroughly ground. Persian powder has been considered superior, simply because it was formerly made under the supervision of the Hungarian Government, who exacted purity and other conditions which insured a high grade, which gave the powder its reputation. The pyrethrum



LEGGETT'S POWDER-GUN IN OPERATION.

grown in California has been proved to be equally as efficacious, when correctly prepared, as that from the Caucasian Mountains; the climatic conditions of the latter having no superior influence, as is generally supposed.

In poisonous powders, London purple is rapidly taking the lead. It is largely used in the public parks and in government experimental farms, and is considered superior to Paris green on account of being more soluble, there being less danger of burning the foliage with it. It is said to go further, and is certainly much cheaper, which is accounted for by its being a by-product. When used as a powder, it also has the advantage of being more readily seen on the plants. The adulterants usually mixed with it are either land-plaster, road-dust, plaster-of-Paris, or cheap flour; and it is advisable to mix thoroughly at least twenty-four hours before use, which allows the adulterant to absorb the poison, making it more effectual. Where small areas only have to be gone over, flour is the best, as it adheres tenaciously to the foliage, and it is more inviting to the insectivorous appetite than minerals. When mixed with flour, one pound of London purple to twenty to thirty pounds

of flour is the proper proportion, according to the tenderness of the plants; mixed with land-plaster or plaster-of-Paris, one pound of the poison to a hundred and fifty pounds of the adulterant; with dry road-dust, one pound of the poison to a bushel and a half of the dust. In making liquid solutions, mix one pound of London purple with two hundred gallons of water, but first wet the powder and form a thin paste to prevent it from forming lumps. It should be put in the water twelve hours at least before use, for the best results. Paris green can be mixed in the same proportions, and in the same manner, as above.

WHITE'S STREET-RAILWAY RAIL AND CHAIR.

THE accompanying illustrations show an improved form of rail for street-railways, designed and manufactured by R. T. White of Boston. Fig. 1 shows the rail in section. Two pendant sides or girders are rolled integral with the top or tread of the rail, thus giving greater strength than the ordinary girder-rails having a central vertical rib. This rail has many advantages over the common form of tram or girder rails, being easier to lay and pave to;

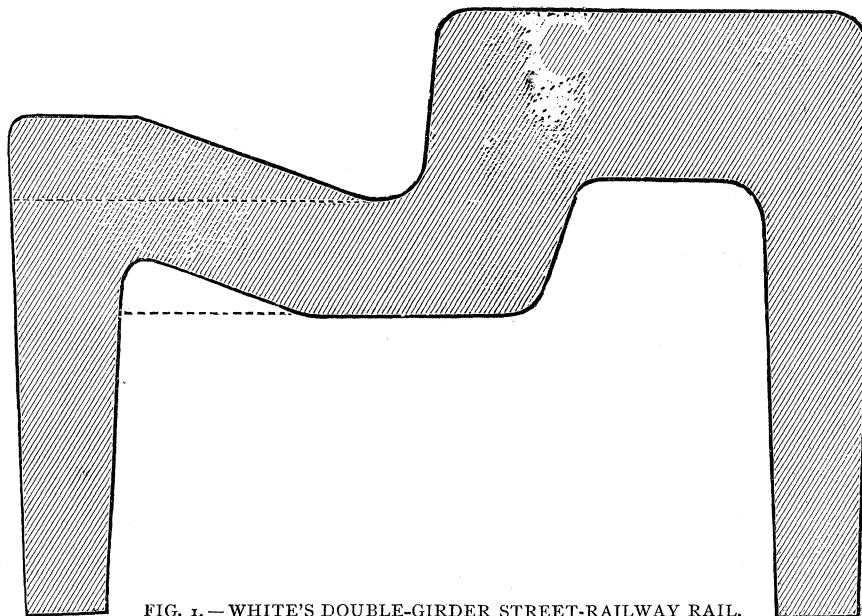


FIG. 1.—WHITE'S DOUBLE-GIRDER STREET-RAILWAY RAIL.

and the paving, on settling, cannot drop under the head and flange of the rail, — a very serious defect with the common form of girder-rails. The top or wearing part of this rail may be made as shown by the full or dotted lines; but, by making it as shown by the full lines, more wearing surface can be obtained on the head of the rail before the flange of the wheel touches the bottom of the groove. Carriage-wheels can easily pass over or out of this rail, and the groove cannot become clogged, as the flange of the car-wheel acts as a wedge as it passes along, forcing stones or dirt out of the way.

Fig. 2 shows the method of laying the new rail. It is secured on a chair by a bolt passing through the pendant sides of the rail and through the upper end of the chair. These chairs are placed at suitable intervals along the rails, and a similar chair of sufficient length is used at the ends, for connecting the rails together, thus making a substantial and practical joint. The chairs are set on and secured to wooden sleepers by lag screws, as shown; but the wooden sleepers may be dispensed with by enlarging the base of the chairs sufficiently to give them a solid bearing when tamped in the ground, or they may be set in concrete. In this case, tie-rods would be used to hold the rails to gauge.

FROM 1877 to 1888, forty-nine cases of leprosy have been treated at the St. Petersburg hospitals. About one-half of these are reported to be of subjects born in the city proper. Of the others, some come from the Baltic provinces, but there are also a few from districts where hitherto leprosy has been unknown.

ROYAL SOCIETY OF CANADA.

THE seventh annual meeting of the Royal Society of Canada took place in Ottawa on Tuesday, May 7. From the secretary's report, it seems that the delay in the appearance of the "Transactions of the Society" was caused by the incomplete nature of many of the papers. Four vacancies were filled during the year, — three in the English section, and one in the mathematical. In 1887 a committee was appointed to consider the proposition of taking steps in the direction of an imperial union of the services of similar societies, in connection with the Imperial Institute, to co-operate in developing and illustrating the resources of the empire. A favorable report having been returned, the committee was further instructed to communicate on the subject with the authorities of the Imperial Institute.

Delegates from affiliated societies were introduced, representing the Society of Canadian Literature, the Natural History Society, the Numismatical and Antiquarian Society, the Society for Historical Study, the Literature and History Society, the Geographical Society, the Quebec Institut Canadien, the Ottawa Institut Canadien, the Field Naturalist Club, the Entomological Society, the

Toronto Canadian Institute, and the Nova Scotia Historical Society.

Mr. Sandford Fleming, in his presidential address, touched on the fact, that, of the eighty original members, seven had passed away, and that the society had reason to congratulate itself upon the justification of all its elections. The address consisted mainly of an examination and inquiry into the origin of the two great races which form the Dominion. L'Abbé Casgrain followed with an address on the objects of the several sections. The scope of the papers may be gathered from the following partial list: "The Study of Political Science in Canada;" "Trade and Commerce in the Stone Ages;" "The Cartography of the Gulf of St. Lawrence;" "Nematophytin;" "De Marseilles à Oran, Souvenirs d'Afrique;" "L'Empereur Maximilian du Mexique;" "The Historical Influence of Physical Geography;" "Canadian Pre-Railway Transcontinental Journeys;" "Trilinear Co-ordinates on the Sphere, and Oblique Co-ordinates in Geometry of Three Dimensions;" "A Problem of Political Science;" "Papers on Higher Mathematics;" "The Ore Deposit of the Treadmill Mine, Alaska;" "The Microscopical Character of the said Ore;" "Fossil Sponges from Beds of the Quebec Group of Sir William Logan at Little Metis;" "Copper Deposits of the Sudbury District;" "Geography and Geology of the Big Bend of the Columbia."

On Wednesday evening a public meeting of the French section was held. Principal Grant addressed the audience on "Who are Canadians?" and L'Abbé Casgrain gave an oration on "The Death of Montcalm."

At a general meeting on Wednesday, and another on Thursday, it was resolved that the council elect four members for three years from the past membership of the council, in order to insure permanency; it was suggested that in future the meetings of the society be inaugurated by a conversazione; the question of extending the term of presidency from one to three or to five years was discussed, and deferred till next session; a committee was appointed to welcome, in the name of the society, the American Society of Mining Engineers in Ottawa in the autumn; a committee was nominated to meet the American Association for the Advancement of Science in Toronto; and the following officers for the ensuing year were elected: L'Abbé Casgrain, president; Principal Grant, vice-president; Dr. Bourinot, secretary; and Dr. Selwyn, treasurer.

Mr. Sandford Fleming entertained a select party of members at luncheon in the Rideau Club, and on Thursday afternoon the entire society was invited to a garden party at Government House.

ELECTRICAL NEWS.

Overhead Wires for Electric Railways.

THE rapidity with which electric street-railways have been introduced into towns and the suburbs of cities, and the success that has attended their introduction, have called the attention of the

system will probably work well on level lines, but can hardly be economically used when grades of four per cent and over are to be taken. The conduit system could possibly be made to work if enough money were spent on it, — \$50,000 or \$60,000 a mile, — but so far it has not been a success. In Boston it has not worked satisfactorily; and at San José, Cal., where it has been from time to time reported as successful, it has turned out a flat failure. In fact, for an extended system of street-railways, the only electric system which would be any thing more than an experiment is the overhead system. In Boston two lines have been in operation for some time; and they have worked so successfully, and have seemed so unobjectionable, that the Board of Aldermen has given permission to the West End Street Railway Company — a company operating all of the important street-railway lines in Boston — to equip their entire system with the overhead electric wires. There can be no doubt of the advantage that this will be to the public. It will allow rapid transit to the suburbs, and in the crowded portions of the town the cars will make much better time than is possible with horses; they will be under better control, and will occupy less space in the streets.

In fact, the question is getting to be, not shall we use electricity on our railroads, but what system shall we adopt? Shall we use the overhead, or shall we wait for a storage-battery? It is

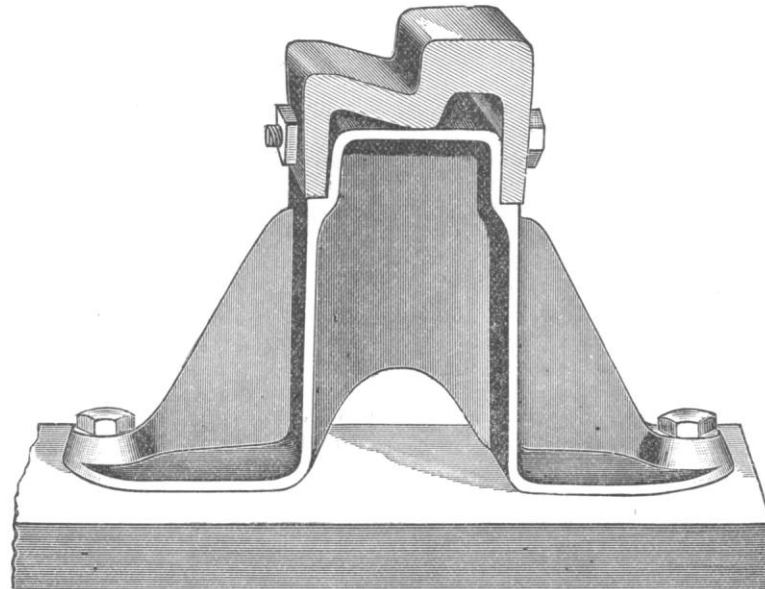


FIG. 2. — WHITE'S DOUBLE-GIRDER STREET-RAILWAY RAIL.

managers of the larger city lines to this method of traction. Its advantages are unquestionable: it is cheap, it is clean, it gives a rapid and easy service to the public, the cars are more readily and safely handled than by any other known method. There is one legitimate objection to it, and but one; and that is the necessity, except in special cases, of overhead wires to convey the electric current from the power-station to the cars. The public is prejudiced, and generally justly prejudiced, against overhead wires. Overhead wires mean to most of us a confused network of telegraph, telephone, and electric-light wires, unsightly and dangerous. But the wires used for electric railroads are very different from these. The poles used to support them are only slightly larger than the ordinary lamp-posts: they may be made even less objectionable. The line consists of a small span wire going from pole to pole, with the conducting wires supported by these, and extending over the track, one small wire for each track. An inspection of some of the latest and best-equipped electric roads shows a marked advance over those of a year or a year and a half ago. If expense is not spared, the most slightly of the present roads can be improved on, and two or three thousand dollars a mile is a small sum when a city road is to be equipped.

There are alternative electrical methods which do not involve an overhead structure, but they are not at the present time successful enough to warrant their general adoption. The storage-battery

probable that many of the managers will decide to put in the overhead system until the secondary battery is ready to take its place. The loss will not be very great, and two or three years' successful operation will more than pay for the change. The equipment of the Boston roads — if they are equipped — will give a decided impulse in this direction.

SOME EXPERIMENTS ON LIGHT AND ELECTRICITY. — The following is from the London *Electrician*: "An experiment described by M. J. Borgman has an important bearing upon the explanation of the remarkable discovery of M. Hallwachs, in which a beam of light seems to act as a conductor for an electric current. The latter experiment consisted in placing a piece of metallic gauze parallel with but insulated from a second sheet of metal. The first is connected with the positive, the second with the negative, pole of a battery, and in one of the leads a delicate galvanometer is placed. If, now, a beam of light be made to pass through the gauze, and to fall on the plate behind, a current is set up in the circuit, and continues to flow as long as the illumination is maintained. It has, moreover, been shown that the action is due to the ultra-violet waves. Now, M. Borgman wanted to ascertain whether or not the effect was instantaneous; that is to say, whether the commencement and the cessation of the current was or was not simultaneous with that of the illumination. M. Borgman probably reasoned, that, if the beam acted in some sense as a con-

ductor of the current, the effect must be instantaneous; while, if the phenomenon resulted from some secondary action, it would probably go on increasing up to a certain point with the duration of the illumination, and it would also probably continue for a time after the light had been cut off. His method of making the test was equally simple and ingenious. The light was interrupted at rapid intervals by means of a rotating disk with holes or slits, and he placed a telephone in circuit with the battery. It is, then, obvious, that, if the effect is instantaneous, the telephone will produce a note corresponding in pitch to the velocity of the disk; if otherwise, there will be silence. There was silence. A make and break in any other part of the circuit could be heard, but not in the beam of light: hence we must seek for some secondary action on the surface of the plates to explain M. Hallwach's experiments."

THE ELECTRO-CHEMICAL EQUIVALENT OF SILVER. — A very important electrical constant — one often used in the measurement of electric currents — is the amount of silver deposited in a given time by a given electric current. Determinations have been made by Kohlrausch, Rayleigh, and Mascart, the results of the last differing from those of the first two by as much as one part in four hundred. Recently Pellat and Potier have repeated the experiments, using to measure the currents an electro-dynamometer constructed by M. Pellat, and taking every precaution to insure accuracy. The result obtained gives 1.1192 milligrams of silver deposited by one ampère in a second. The previous results are, Kohlrausch, 1.1183; Rayleigh, 1.118; Mascart, 1.1156; Pellat and Potier, 1.1192. The mean is very near to Rayleigh's value.

THE VOLTAIC CURRENT OBTAINED WITH BISMUTH IN A MAGNETIC FIELD. — The following experiments are due to Dr. G. P. Grimaldi. A wide U-tube contained a solution of bismuth chloride in hydrochloric acid. In the two limbs of the tube dipped two wires of chemically pure bismuth very carefully polished. One limb of the tube was placed between the conical pole-pieces of a Faraday electro-magnet of medium size in such a way that the surface of the liquid was in the most intense part of the field. The two wires were joined up to a very sensitive Thomson astatic galvanometer. On closing the galvanometer circuit, a current was observed which at first varied rapidly, but which finally reached a permanent value. This was compensated by means of a shunt containing a standard element, and the galvanometer was brought back to zero. If then the electro-magnet was excited by a powerful current, a permanent deflection of the galvanometer was observed; if the magnetizing current was broken, the galvanometer returned to zero. The current produced by magnetism, which the author calls the galvano-magnetic current, is independent of the intensity and direction of the current first observed in closing the galvanometer circuit before the magnet circuit is made. The latter is variable; the former is always in the same direction, — in the galvanometer circuit, from the magnetized bismuth wire to the non-magnetized one; and in the liquid, from the non-magnetic metal to the magnetic one. The intensity of the galvano-magnetic current depends on the state of the surface of the metal, and to get regular results it is necessary to carefully polish the bismuth wires. To give an idea of the magnitude of the electro-motive force of the galvano-magnetic current, the author states that in the various experiments hitherto made under good conditions with various wires, and in various modifications, it has varied from $\frac{1}{12000}$ to $\frac{1}{2400}$ of a Daniell cell, the magnetic field being produced by a Faraday magnet of ordinary size, excited by a current of eight to twelve ampères, and with conical poles seven millimetres apart. With less powerful magnetizing currents, the results are smaller; and, with a current of two ampères, the galvano-magnetic current is scarcely appreciable. The direction of the galvano-magnetic current is independent of the direction of the field: its intensity sometimes varied a little when the field was reversed, and sometimes remained constant.

NOTES AND NEWS.

THE fourth annual meeting of the Science Club of the University of Kansas, Lawrence, was held Friday, May 17. The following is a list of the papers read: "Proximate Analysis of the Mountain Sage," by L. E. Sayre, John Scott, and E. Morris; "On

the Action of Various Organic Acids on Calomel," by E. H. S. Bailey and W. B. Hilton; "Blue-Printing," "Columns of Uniform Strength," and "Maximum Bending Moment in Beams and Arch-Ribs," by E. C. Murphy; "Notes on the *Janida*," and "Notes on Bird-Migration, Spring, 1889," by V. L. Kellogg; "On Some Corrections on the Thomson Calorimeter," by L. I. Blake; "Development of the *Luccinea* and the *Planorbis*," and "The Nervous System of Some Invertebrate Types," by Gertrude Crotty; "The Psychology of Counting," and "A New System of Derived Units," by W. S. Franklin; "A Case of Atavism," by E. E. Slosson; "On the Quality of Commercial Potash and Soda," by George F. Weida; "Coals of Kansas," by E. H. S. Bailey and L. T. Smith; "Methods of Stating the Results in Water-Analysis," by E. C. Franklin; "The *Mallophaga*," by V. L. Kellogg; "The Mode of Respiration of Salamanders," and "Curve of Daily Mean Temperatures for Twenty-one Years," by F. H. Snow; and "Proximate Analysis of the Fruit of the Pawpaw (*Asimina triloba*)," by L. E. Sayre and B. L. Hill.

— At a recent meeting in New York of the American Institute of Mining Engineers, Mr. Oberlin Smith of Bridgeton, N.J., read a paper on the making of nails of good quality from tin-scrap. This process undertakes to use this material just as it is, without trying to separate its constituents at all, and to use it, moreover, for a purpose in which the qualities of both these constituents — namely, the tensile strength and ductility of the iron, and the resistance of the tin to corrosion — are directly employed with advantage. The nail was invented, in its original shape, by Mr. George H. Perkins of Philadelphia, and has been developed, through various forms, until it has almost reached a commercial stage, the machine in which it is to be made in marketable shape being nearly completed. Mr. Smith has been associated with Mr. Perkins in its development. The machine now under construction has been very much simplified, and made enormously strong and heavy. It is adapted to cutting, crushing, griping, and heading the nails at one operation, and can be run as fast as an expert operator can feed the material. Its feed probably varies, with jagged, irregular scrap, from thirty to ninety nails per minute, although straight strips of sheet metal can be fed by hand into a machine running as high as 240 strokes per minute. During the course of their experiments, various forms of nails have been tried. Among others were straight cylindrical nails with conical points, straight square nails with pyramidal and with wedge-shaped points, hexagonal nails, etc. The most practical form seems to be the square taper nail with about the same shape as the ordinary cut nail, but is somewhat stronger and a good deal tougher. The economy of this system of nail-making is obvious. The scrap can be bought for about seventeen cents per hundred pounds, and a boy can make perhaps a hundred pounds of nails per day. The most economical system of manufacture will probably be to run one or more nail-machines at each large "tinshop," set as close as possible to the presses which produce the scrap, so as to avoid the expense of unnecessary handling, and the extra tangling-up incident thereto.

— The bearing of chemistry upon construction is thus illustrated by the *Lumber Trade Journal*: It is safe to say that no two varieties of wood possess the same essential chemical characteristics, and, the instant one possessing much alkali is placed near another that gives acid in its re-action, it will invite rapid dissolution and decay. What is true with reference to wood applies with all the force to the other materials used in structures. Two uprights, the main-stay of a quite large country bridge, rotted off at the ends when bolted together with an iron bolt. New ones were put in, and fastened by wooden pins of the same variety; and ten years have elapsed, and still they stand. In the first instance, beech, which is known to contain much acetate, was used, and the iron soon oxidized, transmitting the rot to the wood, and, though the rest was perfectly sound, the wood about the splice soon rotted off; while in the latter case the same wood from the same tree was used, but the wooden pins did not rust, and the joint remains firm and sound at this writing, and it is now nearly ten years since the renewal was made. Now, if a wood like ash or oak, having less acetate in its composition, had been used, instead of rotting or oxidizing, it would have tended to preserve the iron, hence would last

longer than if fastened with pins made of its own species of wood, or any, for that matter.

— Charles Lamb was possibly not far wrong, says *The Horological Journal*, when he conjectured that Adam had a sun-dial in Paradise. Dials are probably older even than alchemy. The Babylonians had them; though the Egyptians, that wondrous people who knew most of the things the moderns have rediscovered, seem not to have used them. The Babylonians gave them to the Greeks; the Greeks, to the Romans; and the Emperor Trajan is credited with an epigram upon the art of dialing. Naturally dials are most frequent in lands where the sun shines, as a matter of course, and not as a rare complacency. French and Italian gardens are full of them. To the walls of sunny *châteaux* they are fixed in hundreds. In the old days, when there was time for sentiment, and room for it, sun-dials were favorite gifts from great personages to one another,—from people to princes, and from princes to people. Cosmo de' Medici, whose fitful humors so angered Benvenuto Cellini, gave one to the Florentine students of astronomy; and on the wall of Sta. Maria Novella it still marks the time of day. But even in our own cold land of fibre and complexion there are dials not a few. In Mrs. Gatty's book some eight hundred inscriptions are set down; and, as some favorite legends are common to many dials, the recorded number is probably close upon a thousand.

— Mr. G. T. Shepley, the architect of the Leland Stanford, jun., University, states in the *San Francisco Building Advertiser* that the work on the large dormitory in connection with the university has been commenced. The buildings completed, or nearly so, number fourteen, and consist of lecture-rooms, reception-rooms, laboratories, and all the requisite departments for a complete educational course. The dormitory will be situated about a thousand feet from the other buildings. It will be 275 by 145, four stories high, presenting a very imposing structure. The material used is San José stone. The building will accommodate two hundred students. Single rooms will be 18 by 26, and double rooms 24 by 26. Altogether there will be from one hundred and twenty-five to one hundred and fifty rooms. There will only be one dining-room for the two hundred students, and this will occupy the central portion of the lower floor. The kitchen, laundries, etc., are in the basement; but, as the dining-room is raised considerably above the floor on which it is situated, there will be plenty of light and air afforded for the basement. All the fifteen buildings will be heated by steam and lighted by electricity from one central station placed in the rear of the quadrangle. The university will not resemble any of the Eastern universities to any great extent. All the old colleges are built around quadrangles, and in this one point the Leland Stanford, jun., University will resemble them, but in no other. There will be a magnificent view from all the sleeping-rooms of the dormitories.

— M. J. Violle has been investigating the alloy of the standard international kilogram, says *Nature*. The alloy of platinum and iridium in the proportion of ten per hundred, prepared with the greatest care by M. Matthey, is here found to be still somewhat defective. M. Violle's researches show that an alloy of nine parts platinum and one iridium yields more uniform and accurate results, both as regards density and specific heat. The density thus obtained is an absolute constant, incapable of further modification under cold hammering, annealing, or any other severe test.

— In the *Canadian Record of Science* for April, in a paper on the glaciation of eastern Canada, Robert Chalmers, of the Geological Survey of Canada, maintains that the investigations hitherto made in regard to the glaciation of eastern Canada show, that instead of its having been caused by a continental ice-sheet moving over the region from north to south, as has been supposed, local glaciers upon the higher grounds, and icebergs or floating ice striating the lower coastal and estuarine tracts, during a period of submergence, were agents sufficiently powerful to produce all the phenomena observed. The latter theory, with some modifications, is the one so long maintained by Sir William Dawson, who has studied the glaciation of this country for forty years or more. A number of other observers have of late years been at work, however, and Sir William's views are now, Mr. Chalmers holds, about

to receive abundant confirmation. The large mass of new evidence obtained, and now available for co-ordination and study, is, however, so scattered through the reports of the Geological Survey and various scientific periodicals, as to be somewhat difficult of access. A good deal of unpublished material, too, relating to this subject, is now in the hands of the Geological Survey staff. The object in this paper, therefore, is simply to collect and correlate all the main facts within reach relating to this important question, briefly summarizing the results, and referring the student for fuller details to the reports and publications alluded to.

— The following recommendations are given by the Forestry Division of the Department of Agriculture in regard to the cheaper coatings for keeping moisture out of timber: Never apply paint or any other coating to green or unseasoned timber. If the wood was not well dried or seasoned, the coat will only hasten decay. Good coatings consist of oily or resinous substances which make a smooth coat capable of being uniformly applied. They must cover every part, must not crack, and possess a certain amount of plasticity after drying. Coal-tar, with or without sand or plaster, and pitch, especially if mixed with oil of turpentine and applied hot (thus penetrating more deeply), answers best. A mixture of three parts coal-tar and one part clean unsalted grease, to prevent the tar from drying until it has had time to fill the minute pores, is recommended. One barrel of coal-tar (three to four dollars per barrel) will cover three hundred posts. Wood-tar is not serviceable because it does not dry. Oil paints are next in value. Boiled linseed-oil, or any other drying vegetable oil, is used with lead or any other body, like powdered charcoal, which will give substance to it. Immersion in crude petroleum is also recommended. Charring of those parts which come in contact with the ground can be considered only as an imperfect preservative; and unless it is carefully done, and a considerable layer of charcoal is formed, the effect is often detrimental, as the process both weakens the timber and produces cracks, thus exposing the interior to ferments. Lastly, in communities where durable timber is scarce, it will pay to establish a plant for impregnating timber with antiseptics by the more costly process described in "Forestry Bulletin," No. 1.

— At Reinickendorf, a village near Berlin, it is reported by *Building*, a consumptive sanitarium is to be erected on a novel plan, utilizing the supposed therapeutic influence of association with certain animals. A large cylindrical building will be occupied in the upper part by the patients, while the ground floor will be given up to the accommodation of large numbers of milch cows, the exhalations from which will be conducted to the apartments above. A whey and buttermilk diet will also be contributed by the under boarders.

— The iridium anti-friction metal is now being introduced into England. This metal has undergone some very successful tests in America, Professor Thurston having compared the behavior of a brass made of this alloy with one of the Pennsylvania Railroad Company's standard phosphor-bronze bearings. The tests extended over eight hours, the mean speed of revolutions being 400 per minute. The pressure at starting on each brass was 200 pounds, which was increased by an additional 200 pounds at the end of every two hours. The behavior of the two alloys was, it is stated, practically identical. The iridium metal contains no iridium, the term apparently being used simply to indicate that the material is a hard alloy, though it has a low melting-point, and can be cast round journals in place in the same way as babbitt-metal. If desired, however, it can be cast and machined in the same way as ordinary gun-metal.

— A generous gift of \$150,000 was made recently, says *The American Geologist*, to the University of Minnesota by Ex-Governor and Regent John S. Pillsbury of Minneapolis. It was conditioned only on the pledge by the Legislature that the university should not be weakened by the division of the funds that now constitute its endowment, but that the so-called agricultural land-grant (under the law of Congress of 1861) should remain inseparably connected with the university proper. This pledge the Legislature gave. The gift will be used, as intended, to complete and furnish the new Science Hall. At the university of California the

Lick Astronomical Observatory was the result of a large private donation. At Madison, Wis., the Washburn Observatory was largely the gift of the citizen whose name it bears, and citizens of Michigan erected and furnished the Detroit Observatory at the University of Michigan. The donation of Gov. Pillsbury, however, seems to be the first of importance to a State university in behalf of what are generally known as natural sciences.

— A correspondent of the *Revue Scientifique* vouches for the following story: For about twenty years he was in the habit of visiting two or three times each year a farm where was kept a flock of geese, numbering from thirty to thirty-five in the early part of the winter, and in the spring four or five, left for breeding purposes; these also generally being killed a few months later, after the new broods had attained their growth. In the month of July, 1862, on a feast day, the farmer and his men being absent, the geese were forgotten, and were attacked by dogs, which killed the most of them. The next evening at twilight the farmer thought they must have been attacked a second time. He found them flying about in their pen, much frightened, but the dogs were nowhere to be seen. The next day this terror re-appeared at the same hour, as it did on the following day and from that time on. The correspondent of the *Revue* had forgotten this fact, when, ten years later, he chanced to be on the farm one evening, and heard the cackling of the apparently frightened geese. When he asked for an explanation, he was told that this had been kept up from the time they had been attacked by the dogs, that there had been no repetition of the attack, and that the flock had been renewed in the mean time at least three times. If this story is well authenticated, we have a case of the transmission of terror to the third generation in a family of geese.

— Loss and gain of nitrogen, M. P. P. Dehérain has determined by the experiments carried on at Grignon from 1875 to 1889, according to *Nature*. A general survey of the results of these experiments leads to the conclusion that all soils containing considerable quantities of nitrogen in combination, say two grams to the kilogram, lose, if cultivated without manure, far more nitrogen than is absorbed by the crops, but in proportions varying according to the nature of those crops, — more with beet-root, less with maize grown for fodder, still less with potatoes and wheat. But when the ground has thus been impoverished, no longer containing more than 1.45 or 1.50 grams to the kilogram, the loss ceases, and the ground begins, on the contrary, to recover a certain proportion of nitrogen, the gain being much greater on grass-grown than on tilled lands.

— The Swiss Federal Council has invited the European governments to be present at a conference to be held in Berne next September. The object of the conference is international legislation in regard to labor. The council suggests the following points for the consideration of the conference: the prohibition of labor on Sunday, or at least rest on one day out of seven; a fixed minimum age for the admission of children into factories; the maximum length of a day's labor for young working-people; the prohibition of the employment of young men and women in pursuits especially injurious to the health or dangerous; and the restriction of night-work for young men and for women.

— To-morrow the first working detachment of the Nicaragua Canal Company will leave this port for Greytown. The party is in charge of Lieut. Usher, United States Navy. A large number of friends interested in the success of the enterprise has been invited to accompany the expedition down the bay to wish it *bon voyage*.

— It is proposed to hold an international novelties exhibition in the Great Central Hall, London, commencing May 29. The exhibition, according to the prospectus, has been undertaken for the purpose of introducing and bringing before the public the many meritorious novelties in the arts, sciences, and manufactures which have been invented and produced in recent years, not alone in Great Britain, but also on the Continent and in the United States. The Central Hall contains 26,000 superficial feet floor-space, and is situated in the very heart of London. The hall is lavishly decorated, and has been designed with special attention to the re-

quirements of an exhibition. Of the space at the disposal of the executive, 5,000 superficial feet have been guaranteed to the commissioners representing the exhibition abroad, who are now selecting the most recent and eligible inventions and novelties produced in their respective countries. A certificate has been obtained from the Board of Trade, protecting any unregistered patents and designs which may be shown at the exhibition.

— A new adulteration of coffee has been recently discovered in Germany. M. Stutzer of Bonn states that this artificial coffee is made from burnt farina, afterwards agglutinated by the aid of dextrine or some similar substance. In Cologne there are two factories which turn out these coffee-beans.

— The fourteenth annual meeting of the American Association of Nurserymen will be held in Chicago on June 5 and 6. The programme shows that addresses on an unusually wide range of topics may be expected from speakers well qualified to give instruction. These meetings have proved of great value, both from an educational and from a business point of view, and the nurseryman who neglects to attend them fails to live up to his privileges.

— Engelmann of Leipzig has undertaken the republication of a number of classical memoirs under the editorship of Professor W. Ostwald of Leipzig. The first memoir is the well-known paper of Helmholtz on "The Conservation of Energy," first published in 1847. Other memoirs of Jauss and of Dalton will follow at an early date. The title of the series is "Die classiker der exacten Wissenschaften."

— The Council of the Geological Society of America recently held a meeting at Washington, according to *The American Geologist*. Nominations for fellowship were made to the society of about fifty candidates, all of whom had expressed a desire for election. Professor C. H. Hitchcock was designated to make arrangements for an excursion from Toronto, and another attempt is likely to be made in favor of the Huronian region. He was instructed to correspond with the local committee at Toronto, and with the officers of the Canadian Survey. The programme of the meetings of the society at Toronto was ordered to be independent of that of the association. The committee on revising the constitution held a meeting, and decided on several important matters relating to the constitution. The committee on plan of publication, through Mr. W. J. McGee, secretary, made a voluminous report embodying facts concerning the manner and success of publications by various leading scientific societies in Europe and America. This committee will render a final report, making recommendations of its conclusions to the council at its next session, probably at Toronto.

— Work has just begun on a new building for the Massachusetts Institute of Technology, Boston. The building, which is to include five stories and a basement, will measure 148 by 50 feet, being built of brick with sandstone trimmings. It will be designed after the order of mill-construction, and will cost about \$70,000. The basement and the greater part of the first two floors are to be occupied by the department of mechanical engineering. Cotton machinery, hydraulic testing-machines, shafting tests, and testing-machines for the strength of materials, are to be put in here. The light-running machinery is to be located on the second floor, and above this the department of civil engineering is to be situated. The new building will probably be completed about the first of next winter.

— According to an English provincial paper, a Mr. Cash, a board schoolmaster, and Mr. Pringle, a solicitor, were out photographing, and a plate was exposed on a river-view near Ipswich. When the plate was developed, "there was plainly revealed, in the foreground of the picture, the figure of a woman apparently floating upright in the water, as it is declared that drowned bodies sometimes will, after immersion for a certain length of time. The face and head are clearly outlined; the arms are hanging straight by the side of the body, which is clad in ordinary female attire, and is visible to the waist; and the portrait generally appears to be that of a tall and comely young woman." The schoolmaster and solicitor, apparently thinking there was some peculiar phantom in the river invisible to the eye, but able to impress the plate, took a chief

of police into their council; and the collective wisdom of the three took the form of trying to capture the phantom by dragging the river. In commenting on this, *The Photographic News* expresses the opinion that possibly by this time Messrs. Cash, Pringle, and the chief of police have learned that phantom images on gelatine plates are not extremely rare, as a minute hole in a drying-cup-board or box will often cast an image on a plate. Again, such phantom images occasionally arise from a minute hole in the camera, plate-box, or even the dark slide. Most likely a little inquiry will serve to identify the original of the phantom portrait,

—At a late meeting of the Minnesota Academy of Natural Sciences, Mr. A. D. Meads of the Minnesota Geological Survey read a description of the Stillwater (Minn.) deep well, we learn from *The American Geologist*. It was begun in June, 1888; and the work has continued, with little interruption, up to the present time, when the depth has reached about 3,400 feet. Gas, probably local accumulations of marsh-gas along the shore of Lake St. Croix, led to the drilling; but a spirit of laudable curiosity to know what is below the city, on the part of several of the citizens who pay the costs, has taken the place largely of all expectations of finding gas, and is now the principal motive for continuing the work. The well starts at about 740 feet above the sea, and after passing through 701 feet of drift, white, friable sandstone, and green shales, belonging to the St. Croix and so-called Potsdam of the North-west, enters a series of dark-red and brown shales and brown felspathic sandstones, which exhibited a thickness of more than 1,500 feet. These gradually assume the characters of a volcanic detrital tuff,—"amygdaloidal," calcitic, kaolinic, still brown, slightly silicious,—and finally, at the depth of about 3,300 feet, unmistakable beds of trap-rock were encountered, alternating with sandstone beds. At this depth some grains of native copper were seen in the drillings. Water was found in the sandstones near the top of the drill, and down to the depth of about 740 feet. Small quantities of salt water were obtained at about 1,950 feet, and at the depth of 2,250 feet a small amount of gas was said to have been noted in connection with another stratum giving brine. Mr. Meads's main conclusions were as follows: 1. The Stillwater well is wholly below the Trenton limestone. 2. From 717 feet to the bottom of the well is Keweenaw. This thins out or runs deeper toward the south, not appearing at the depth of 1,160 feet at Hastings. 3. The Keweenaw rocks at Stillwater are almost identical with those at Keweenaw Point. 4. The well may be of some value as a source of water-supply; but as a source of gas the prospects are poor—or we might say there are no prospects whatever. 5. The well is of great value to geologists, as it fixes the place of the Keweenaw below the light-colored sandstones of the North-west, and hence effectually removes them from the mesozoic age. In several places the brown shales and sandstones that here are shown to overlie the traps, have been pierced by wells in Minnesota, but not penetrated, and hence the question was left open as to the age of the traps. This question is, therefore, no longer a debatable one.

—Mr. Robert Damon of Weymouth, England, the well-known naturalist and geologist, died suddenly on Saturday, May 4, from heart-disease.

—The following resolution of the government of Bombay, which has just been published, tells its own story, and, as *Nature* believes, adds another to the already numerous examples of the well-judged munificence of the Parsee community of Bombay. The resolution is entitled "Scientific Medical Research." "(1) The sum of Rs. 75,000 having been placed at the disposal of his Excellency the Governor by Mr. Framjee Dinshaw Petit, for the purpose of erecting and fitting a laboratory for scientific medical research, on a site which has been approved by the donor in the immediate vicinity of the Grant Medical College, the governor in council has much pleasure in accepting the offer, and, in doing so, desires publicly to thank Mr. Framjee Dinshaw Petit for his munificence in supplying an institution the want of which has long been felt by those most interested in promoting the cause of higher medical education in this presidency; (2) the governor in council is pleased to direct that the institution shall be called 'The Framjee Dinshaw Petit Laboratory for Scientific Research;' (3) instructions for the

preparation of the necessary plans and estimates for the proposed building have already been given."

—Last winter the Vienna Medical School was attended by one hundred and fifty British and American medical graduates, among whom were many Edinburgh men. As many medical students, on their arrival at Vienna, do not know German, the *Vienna Weekly News* has opened a special "medical inquiry office" near the hospital, where information as to lectures, lodgings, etc., is given without charge to British and American medical men. The same journal publishes weekly a list of forthcoming courses of lectures at the Universities of Vienna and Berlin.

—At the Academy of Sciences, April 29, we learn from *Nature*, M. G. Lippmann read a paper on "A Means of Obtaining Photographs of True Chromatic Value by the Use of Colored Glasses." By the judicious employment of green, yellow, and red glass in the way he explained, excellent results have been obtained even with present plates, notwithstanding their greater sensitiveness to blue. The impressions are described as clear, and free from brown patches; the green foliage, the red or yellow draperies, instead of yielding brown tints, being reproduced in delicately modelled design, as in a well-executed engraving.

—The British consul-general at Patras, in his report for the past year, referring to the Corinth Canal, says that the managing committee has decided to defer payment of interest due to the shareholders. The canal was to be completed within 1888, at a cost of 30,000,000 francs; but this is not possible before 1891, at a cost of double the estimated expenditure. The canal is nine-tenths of a mile in length. According to the original plan, it was reckoned that 8,000,000 cubic metres of earth should be extracted at the cost mentioned, which included 5 per cent interest per annum to shareholders. A committee having been appointed by the government to inquire into the difficulties which have arisen, it was informed that the period for completing this work should be extended, and that the angles of slope should be reduced, and the sides protected by walls to prevent any earth-slips. On account of these alterations, the period for completing the work is extended to November, 1891, the amount of cubic metres of earth to be extracted is increased to 10,000,000, and the cost to 60,000,000 francs.

—According to the latest educational report of 1884, only 1,466,913 of the 15,000,000 children in the Russian Empire attended schools. About 90 per cent, therefore, of young Russia receive no instruction at all. In 60 governments there is only one school for secondary instruction to every 18,000 boys and 22,000 girls. Only 63 per cent of the boys of an age to attend a public high school can be accommodated. For girls, the number of such schools is even more insignificant. The schoolmaster cannot be said to be abroad in Russia yet.

—A novel idea has been put into execution in the machinery hall of the Paris Exhibition, with a view of facilitating the circulation of visitors in the vast building. Two travelling platforms sixty feet long, and capable of carrying ten tons each, are mounted upon the latticed iron girders that connect the columns carrying the shafting. Visitors will be admitted on payment to these platforms, which will be caused to traverse up and down the machinery hall by electric transmission. Access to the platforms will be obtained by elevators placed at each end of the machinery hall.

—The committee appointed to arrange the meeting of the International Congress of Geologists for 1891, according to *The American Geologist*, met in Washington April 20, and elected the following officers: permanent chairman, Professor J. S. Newberry; vice-chairman, G. K. Gilbert; secretary, H. S. Williams. The committee also added to its number the following gentlemen: Dr. T. Sterry Hunt, Professor E. D. Cope, and Dr. Persifer Frazer. Provision was made for three sub-committees,—(1) on the scientific programme of the congress, (2) on excursions, and (3) on arrangements in Philadelphia. The committee adjourned to meet at Philadelphia in November at the time of meeting of the National Academy. A majority of the committee were present at the Washington meeting.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....\$3.50 a year.
Great Britain and Europe..... 4.50 a year.
Science Club-rates for the United States and Canada (in one remittance):

1	subscription	1 year.....	\$ 3.50
2	"	1 year.....	6.00
3	"	1 year.....	8.00
4	"	1 year.....	10.00

Communications will be welcomed from any quarter. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

VOL. XIII. NEW YORK, MAY 24, 1889. No. 329.

CONTENTS:

THE DAFT ELECTRIC ROAD IN CIN- CINNATI..... 391	NOTES AND NEWS..... 398
INSECTICIDES AND THEIR APPLICA- TION..... 393	READING AS A MEANS OF TEACHING LANGUAGE TO THE DEAF <i>A. Graham Bell</i> 402
WHITE'S STREET-RAILWAY RAIL AND CHAIR..... 396	EXPLORATIONS OF CAPT. BINGER.... 404
ROYAL SOCIETY OF CANADA.... 396	GUSTAVE EIFFEL 406
ELECTRICAL NEWS.	MENTAL SCIENCE.
Overhead Wires for Electric Rail- ways..... 397	Psychic Cures..... 406
Some Experiments on Light and Electricity..... 397	BOOK-REVIEWS.
The Electro-Chemical Equivalent of Silver.... 398	The Primitive Family in its Origin and Development. 407
The Voltaic Current obtained with Bismuth in a Magnetic Field.... 398	Hygienic Physiology..... 408
	A Hand-Book of Cryptogamic Bot- any..... 408
	Outlines of Lessons in Botany.... 408
	AMONG THE PUBLISHERS..... 408

READING AS A MEANS OF TEACHING LANGUAGE TO THE DEAF.¹

"I would have a deaf child read books in order to learn the language, instead of learning the language in order to read books."

It delights me to observe in America a gradual change from the scholastic method of teaching language to that which has been so properly called by Mr. Scott Hutton the "natural method." But there is one point in the natural method to which I would direct your attention.

When we study the methods by which languages are naturally acquired by hearing children, we observe that comprehension of the language always precedes a child's attempt to express ideas in that language,—he understands the language before he uses it; whereas, in our attempts to apply the natural method to the deaf, we try to make the child use the language before he understands it.

I was very much struck by the remark of Mr. Job Williams, that it is practice, practice, that gives a perfect command of language; that *it is the frequency of repetition of words that impresses them upon the memory*. Now, what sort of repetition do we give to the hearing child? Will any member of this conference make the experiment? It is an interesting one. Take a book in-

¹ An address delivered before the sixth national conference of superintendents and principals of institutions for the deaf (Gallaudet meeting), held at the Mississippi Institution, Jackson, Miss., April 14-17, 1888, by Alexander Graham Bell.

tended for children's use, and read it aloud. Test the speed of your reading, and you will find that two hundred words a minute is not a rapid rate.

A stenographer would say that one hundred and fifty words a minute is above the average rate of public speaking; but this is for language in which long words are of frequent occurrence, and where a deliberateness of utterance is employed that is uncommon in talking to children. Not only do short words predominate in our conversation with children, but mothers and nurses gabble at such express speed that a stenographer would probably give up in despair the attempt to transcribe the conversation. I am convinced from experiment that the average rate of nursery gossip exceeds two hundred words a minute. However, to be well within the mark, let us assume one hundred and fifty words as the average rate, and calculate upon this supposition the number of words presented to the ears of a hearing child in the course of a day. Let us suppose that if these words were concentrated into one continuous talk, without any pause, it would amount to a speech of four hours in length, and surely this is not an excessive assumption. One hundred and fifty words a minute amounts to nine thousand words an hour, or thirty-six thousand words in four hours. This means that we shower at the ears of the hearing child no less than thirty-six thousand words a day; and, as the whole vocabulary we use in talking to children hardly exceeds three hundred words, this means a very great daily repetition.

We not only talk to a child at the rate of thirty-six thousand words a day, but we do this for three hundred and sixty-five days in the year (we do not stop on Sundays); and we do this for two years at least before we expect the child to turn round and talk to us. If, then, we attempt to apply to the deaf the natural method of learning language, what sort of repetition of words to the eye should we give the deaf child before we exact from him any great efforts at English composition? In the natural method of learning language, *comprehension always precedes expression*. But in our schools for the deaf this process is generally reversed. For example: in our sign-institutions a story is told in signs, and pupils who know little or nothing of the English language are required to go through the drudgery of writing out the story in words. Would not the converse process be more natural and profitable? Even in schools where the sign-language is not employed, action-writing is largely resorted to. For example: a teacher will take a book from a pupil, open it, pretend to read it, then close it and lay it upon the table. She then asks her class to express in English words what she has done.

While this plan furnishes an admirable exercise in composition for older pupils, it is surely out of place with pupils who cannot understandingly read an ordinary book. It reverses the process of nature, which demands that comprehension shall precede expression; that *a child must understand a language before he uses it*.

Now, we know perfectly well that if we can repeat words to the eyes of deaf children with any thing like the frequency and clearness with which we present them to the ears of the hearing, the deaf will come to master the language by the same natural process that produces comprehension in the hearing child. The great difficulty is how to do this. The speed of writing, even at a scribble, hardly exceeds thirty words a minute. The speed of the manual alphabet can be made to approximate one hundred words a minute, but very few teachers exceed an average speed of eighty words per minute. It is obvious, then, that the teacher cannot, by his own exertions, even approximate to the speed of speech.

Is there no hope, then, for the deaf child? Must the acquisition of English always be to him a long and laborious task? Must he acquire imperfectly, after years of labor, a language which is mastered by the hearing infant before he is four years of age, and which foreigners, commencing at the age when the deaf child enters school, acquire in a few months? I do not think so. I think that there is hope for the deaf child by the adoption of a plan that can be ingrafted on any system of instruction.

Though the speed at which we write is limited to about thirty words a minute, the speed at which we read is very different, especially when the words are presented in print so that the letters are clear and unambiguous. I gave an interesting novel the other

day to a friend, and noted the time when the reading began, and also the time when the book was closed. I then made a calculation of the number of words read, and I found that *more words had been read in an hour and a half than a hearing child hears in the course of a day.*

Other experiments have convinced me that the speed of silent reading, at least for those who know the language, averages from three hundred to even four hundred words a minute. I say, then, there is hope for the deaf, by putting books before them and accustoming them to form the habit of reading.

I would urge upon all superintendents and principals of schools for the deaf the importance of introducing reading as a regular school exercise, for the purpose of teaching language. I would introduce into the very youngest classes the practice of reading, *regardless of the fact that the children may not understand the meaning of the words on the printed page before them.* By this practice a repetition of words to the eye would be secured, which could not probably be obtained in any other way, and reading would co-operate with the regular instruction of the schoolroom to bring about a gradual comprehension of language.

I would place in the hands of the youngest pupils, in printed form, the stories that hearing children love to hear, and require them to read those stories, whether they understand them or not, without giving them any explanation of the meaning. Then, after their allotted task is completed, I would give them a reward.

I would show them a picture, or act the story out in natural pantomime. I do not hold, with many of my friends, that signs have not their use. I believe that signs, like pictures, are capable of being used so as actually to facilitate the acquisition of our language by the deaf. *The proper use of signs is to illustrate language, not to take its place.*

I do not know, however, if you will applaud me when I say that I do not here allude to the sign-language. There is the same distinction between pantomime and the sign-language that there is between pictures and the Egyptian hieroglyphics. Egyptian hieroglyphics consist of abbreviated conventionalized pictures, just as the sign-language consists of abbreviated conventionalized pantomime. No one will deny that the exhibition of a picture may add interest to the story that we tell a child. It illustrates the language, and it may be of invaluable assistance to him in realizing our meaning; but is that any reason why we should teach him English through Egyptian hieroglyphics?

The moment you teach one language through another, the pupil thinks in the language of communication, and acquires the other as a foreign tongue, just as the hearing children in our public schools continue to think exclusively in English, however many languages may be included in their curriculum of studies. The natural method demands that you shall teach a language *by using it for the communication of thought without translation into any other tongue.* If you want your child to learn German or French, the English language is an obstacle in the way, and retards his mastery of the foreign tongue, just as the use of the sign-language in our institutions retards the acquisition of English. If you send your child to Germany or France, or so surround him with German or French speaking people that communication is carried on exclusively in one or the other of these languages, he acquires the French or German as a native tongue.

I have no doubt that all things have a use, and even the sign-language may have a use in missionary work among the adult deaf; but I do not think it should have a place in the school, or be used in the instruction of the young, for it comes between the deaf child's mind and the English language he is striving to master.

If words are impressed upon the memory by frequency of repetition, then *the duller a pupil is, the more necessary is that repetition,* and the more harmful the sign-language.

But I am wandering from the subject. If we make a deaf child, perforce, as a regular school exercise, read, not a few paragraphs, but pages upon pages of a book, he will obtain that repetition to the eye which the teacher cannot give him by writing or by the manual alphabet. Let the pupil spend half an hour or an hour a day in reading (or spelling upon his fingers) the language that describes a fascinating tale. Do not show him a picture, do not

make him a sign, do not give him any explanation of the meaning until he has finished his allotted task. Then let the story be acted out, and let pictures be freely used, till he gets the meaning, not necessarily of the individual words and phrases, but of the story as a whole. He learns thus that the printed language in the book expresses a pantomime, or a series of pictures; that it represents, indeed, a narrative that absorbs and fascinates him.

Now, when he is called upon to go through his next daily task, he knows that the language expresses a story of some kind that will interest him, and all the time he is reading or spelling his mind is being exercised. Curiosity compels him to speculate, and he wonders what sort of a pantomime will be acted out, what sort of pictures will be shown him. *He frames in his mind an hypothetical story,* which may or may not be right, but the pantomime or pictures will ultimately correct it. *He is deriving ideas of some sort directly from the printed words.* This is the sort of exercise that the child needs. This is the kind of mental operation that goes on in the mind of the hearing child when he sits on his father's knee, and listens to the story of adventure or to the fairy-tale. In both cases the comprehension of the language is imperfect; in both cases errors are corrected and interest aroused by the exhibition of pictures, or by the use of dramatic gestures and natural pantomime.

I therefore strongly recommend the introduction of reading as a school exercise, — the introduction of interesting stories expressed in ordinary language, idiomatic phrases and all, not language stilted in expression, containing sentences exclusively arranged upon simple grammatical models. If the pupil is to make progress in his knowledge of ordinary language, the language must be above him, and not degraded to an unnatural level. Teachers may say, "Why use idiomatic phrases that cannot possibly be explained to the deaf child?" But he never can come to understand them until he has seen them, any more than the hearing child can understand them until he has heard them. The hearing child learns to understand by hearing, and the deaf child will come to know by seeing. Frequency of repetition will impress the idiomatic phrases on his mind, and much reading will bring about this frequent repetition in ever-varying contexts.

I may allude here to an experiment that I made upon myself, which has an important bearing on this whole subject. I obtained a work upon the education of the deaf, written in the Spanish language (of which language I knew nothing). I determined to ascertain how far I would come to understand the language by forcing myself to read the book. I read very carefully thirty or forty pages, and could make but little of it. The Latin roots helped a little, and I understood a few technical words here and there, but that was all. I refused at first the aid of a dictionary, for a dictionary stops the current of thought. I read thirty or forty pages, and then paused.

Now, a number of words had occurred so frequently that I remembered them, though I knew not their meaning. These words I sought in the dictionary, and then I resumed my reading. I found that these words formed the key to the next thirty or forty pages, and that the meaning of many expressions that would otherwise have been obscure became manifest. New words also explained themselves by the context.

Every now and then, after reading a few pages, I resorted to the dictionary, and sought the meaning of those unknown words that I could remember without looking at the book. I then turned back to the beginning and read the whole a second time, and I was delighted to find that a very great portion of the meaning of that book revealed itself to me. Indeed, I felt convinced that, if I wanted to comprehend the Spanish language, all I had to do was to read, and read, and read, and I should come to understand it.

The application to the deaf is obvious. The methodical instruction in the schoolroom, and the efforts of the teacher, take the place of the dictionary to the deaf child, and reading, reading, reading, with a desire to understand, will give that frequency of repetition to the eye that is essential to the mastery of language. To express the theory in a single sentence, *I would have a deaf child read books in order to learn the language, instead of learning the language in order to read books.*

Now, the books that are best fitted for this end are not those which are most commonly found in school libraries intended for the use of deaf children. We may be guided in our choice by the age of the child. We should place in the hands of the child such books as are of absorbing interest to hearing children of his age. If we wish the child to learn language, quantity of reading is more important than quality. For little children, such stories as "Jack the Giant-Killer," "The Three Bears," "Cinderella," and all the host of fairy-stories that so fascinated us when we were children, will be the best. For boys of twelve and thirteen I am afraid that the so-called "blood and thunder" novels would teach more language than "Stanley's Travels in Central Africa," or the best text-books of history. It is not necessary, however, to place in the hands of deaf children books of doubtful character, in order to give them reading of absorbing interest, while the press of this country continues to furnish such fascinating, entertaining, and at the same time elevating and improving literature for the young as has been prepared for them by such writers as Louisa Alcott, Elijah Kellogg, Margaret Sangster, and the scores of other authors of juvenile books of our time. A plentiful supply of interesting tales should be provided, sufficiently short to be read through at a single sitting, and of a character that could be illustrated by pictures and natural pantomime. Of course, suitable selection must be made of subjects; but I cannot too strongly impress upon you my conviction, that, *for language-teaching, mere quantity of reading is more important than quality.* For advanced pupils, the society novels and plays that are usually banished from the libraries of our institutions are what are wanted, especially those society novels that are written in conversational style, and abound in questions and answers. Ordinary books of history and travel are too often written in what may be called "book language," and not in the language of the people. But in novels and plays will be found the language of conversation, and these also are the books that will stimulate the pupil to read.

As your pupils become familiar with the printed page, they will take in words by the eye with greater and greater rapidity, until ultimately a speed of reading will be obtained of from three hundred to four hundred words a minute. Think what this means if the child reads for only an hour a day during the whole period of his school course! Think, too, of what value the habit of persistent reading will be to your pupils in adult life!

I believe, that, in the acquisition of language by the deaf, reading will perform the function that hearing does for the ordinary child. I do not think that any more important habit can be formed by the pupil than the habit of reading; for, after all, the utmost that you can do for his education in his school life is to introduce him to the wider literature of the world.

EXPLORATIONS OF CAPT. BINGER.

MORE than two years have passed since a marine officer set sail from Bordeaux (Feb. 20, 1887), destined to become renowned as a great explorer. After having for some time conscientiously studied the customs and the language of the people living about the Senegal, Capt. Binger returned to France, harboring the plan which he is about to execute.

His numerous studies and careful researches culminated in the following plan: to fill the large blank space which on our charts is situated in the bend of the Niger; and to connect the investigations and surveys made on the right bank of the river by French officers, and previously by the French explorer René Caillé, with those of Barth and with the surveys of the lower course of the Niger.

His first objective point was to be the city of Kong, the situation of which is approximately given on all our maps. According to one authority, it was said to be a great market-place, a place of meeting for caravans, and a centre of trade; while, according to other authorities, its existence was a matter of doubt, as this name of "Kong" ("mountain") was said to denote merely the watershed between the Atlantic Ocean and the Gulf of Guinea. The plan once conceived, Capt. Binger, on account of his indomitable energy and his perfect health, was the right man to carry it through, in the face of serious dangers. It required a march into unknown

regions. He was to be the first white man seen by the natives of that region; and his knowledge of the native tongue, spoken on the banks of the Senegal and the upper Niger, was of no use to him when once he had entered the unknown territory, as the language in the region to be traversed differs from that spoken throughout the French possessions.

On the 15th of May, Capt. Binger passed the post at Kayes on his way to Bammako, whence he was to start. From this point, in the beginning of June, he addressed a letter to the *almamy* ("chief") Samory, — the same who, by the treaty of March 23, 1887, had placed his states under French protection, — informing him of his intention to march into his country. The *almamy* pleaded that the war with King Tiébe, his powerful neighbor to the east, and the unfortunate condition of his country, would not permit him to receive the traveller, and refused to receive him. After a short time, however, he changed his mind; and, hoping to turn the chances of war in his favor, he wrote to Col. Gallieni, governor of Senegambia, asking him to send a re-enforcement of thirty soldiers from the colony. This request decided Capt. Binger to march on. He only wanted a pretext for doing so, and hoped he would be able to study the position of King Samory, and report to the commander of the French Sudan.

In the war mentioned above, Capt. Binger had tried to act as mediator. He settled upon the 30th of September as the date of his departure, but Samory interfered. First, his son, Karamoko, warned Capt. Binger that the roads leading to Kong and Tegrera were not safe, that it would be preferable to wait, and adduced many other reasons to induce him to give up his plans.

When Capt. Binger insisted upon his departure, Samory declared that he would not let him depart until he had taken Sikasso and several other cities in the neighborhood of Kong. This answer did not satisfy Capt. Binger; and therefore he demanded a final answer from Samory as to whether or not he would give him permission to traverse his country; but again no definite answer, and pretexts without end were the only result. Tired of these performances, Capt. Binger decided to move on as soon as practicable, and run the risk of Samory's hostility; but his energy and his firmness had been effective. He soon after received a confidential visit from the king and his son, begging him not to forget them, and to bring them some cartridges on his return.

The return to Benokubugula was effected by way of Saniena and Komina. Here, again, Capt. Binger found traces of the ravages of war. Komina, which some years before consisted of seventeen villages, — a much-frequented centre of almost four thousand inhabitants, — was nothing but a ruin. A few lemon-trees bore fruit as an emblem of former prosperity. "Since the *almamy* has come here," said a native to the captain, "the land is lost; the soil was good; one mule cost *ba wuoro* ('fifteen francs'); now we can barely find enough to eat."

On the 7th of October, Capt. Binger re-entered Benokubugula, tired out, but still in good spirits. With the exception of the information gained as to the position of the *almamy*, his journey had been void of results.

After resting for several days, Capt. Binger resumed his march on the 16th of October, but not without having to overcome the same obstacles he had met with at Wolosebugu and Sikasso, — that of being unnecessarily detained. Near Tegrera, threatened by the inhabitants with the loss of his head if he proceeded farther, he was deserted by his escort, and at Furu — the boundary of the lands of Samory — he had to pay heavily for the permission to cross. At last he entered the dominions of Tiébe, accompanied by a guide and two men from Niele, captives of Pegue, chief of this part of Follona.

The captain first crossed Pomporo, where he was not disturbed, although he had not been officially received by the dignitaries of the village. At Dionmantene several men joined his small caravan.

After he had arrived within five miles of Niele, he was taken sick with bilious-fever, and during this time was well treated by Pegue, who daily sent him eggs, chicken, and honey.

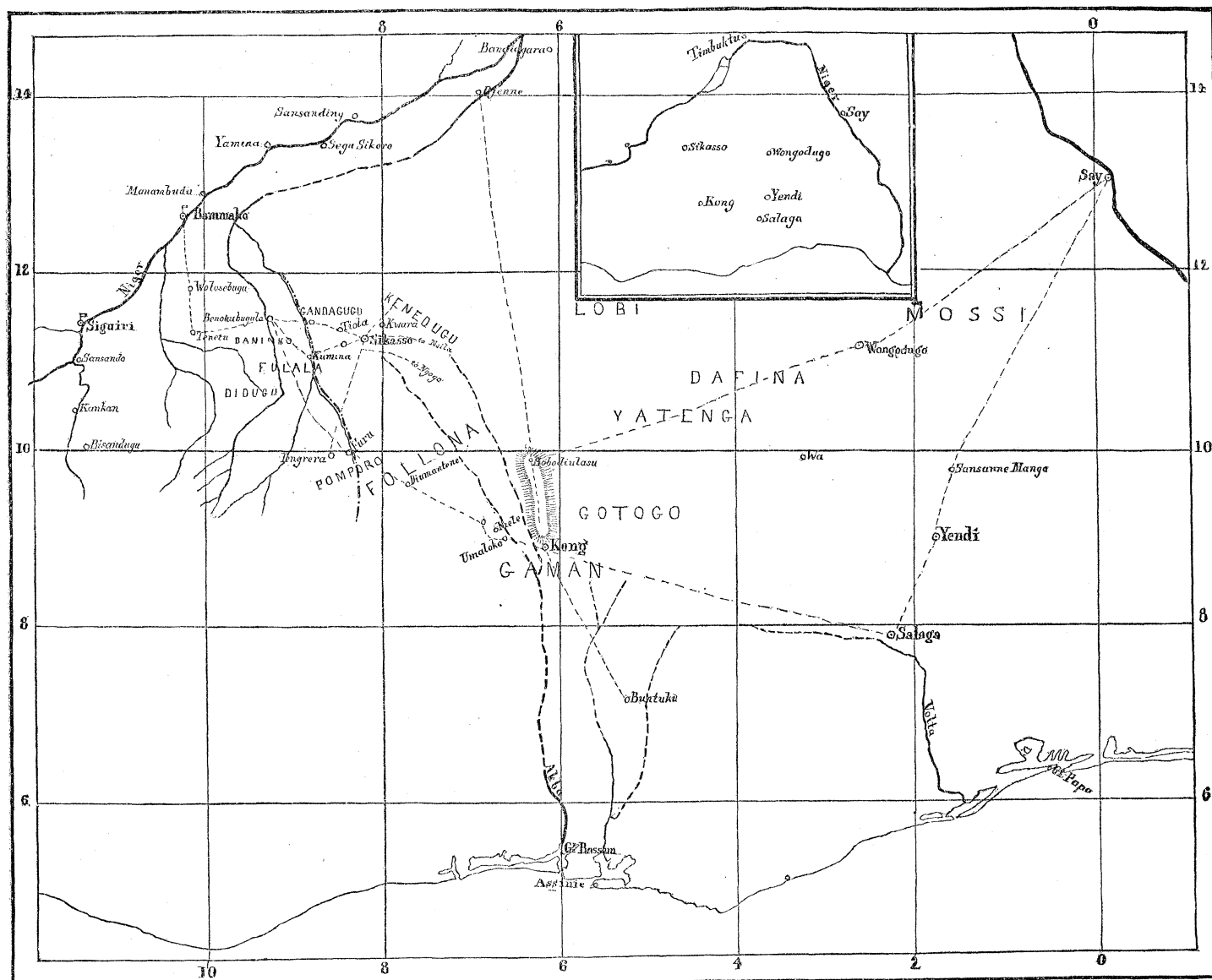
During his rapid convalescence he tried his best to persuade Pegue to admit him to his capital, but in vain. Pegue refused, as he was influenced by his *kenielala* ("magicians"), who associated

the death of Tidiani, shortly after the departure of Lieut. Caron from Bandiagara, with the death of the chief of Furu two days after the passage of the caravan. He was therefore obliged to depart without having seen either Pegue or his capital; at least, he had received all assurances of Pegue's friendship for the French, and his promise to permit the passage of any Frenchman, provided he came alone, and not on horseback. There was no use mentioning a treaty, and the situation was not favorable.

If Samory was successful, he would reduce Niele to ashes. Tiébe, in his turn, would do the same. An alliance between Tiébe

It is divided into seven large parts and several suburbs, and contains one grand mosque and several of less importance. It is under the government of the family of Wattara. The *fama* is called Wamoko-Ule-Wattara; the chief magistrate, Diawara-Wattara; the religious chief of the population, a Musselman, is the *almamy*, Sitafa-Sakhanoko. The chief products of industry are woven goods and indigo dyes. At Marrabatu, one of the suburbs, there are more than forty dyeing-establishments.

To return to Capt. Binger, he was received with a good deal of distrust by the people, who saw in him a spy of Samory's. But as



CAPT. BINGER'S JOURNEYS IN THE NIGER REGION.

and Pegue was out of the question, because the former was detested for his cruelty, and the latter would not accept the proffered conditions. On the 3d of February, Capt. Binger left the village, and, passing Niele, started for Umaloko, in the country of Kong. He was accompanied by one of Pegue's servants, who was to lead him safely into the first villages of the country of Kong.

On the 20th of February he arrived at Kong, having traversed two great rivers from 40 to 80 metres broad, which, coming from Sikasso, flow towards the south, and unite shortly before reaching Kong. They form, without doubt, either the Aleka (Abka or Akbo) or the Volta.

Kong, situated in west longitude $6^{\circ} 9' 43''$, and north latitude $8^{\circ} 54' 15''$, is a city of ten thousand inhabitants, and lies in a large plain at an altitude of from six hundred to seven hundred metres.

the marabouts, the leading class, decided in his favor, his safety was assured.

From the latest news, dated at Kong, March 10, and received at Bammako June 21, it was seen that Capt. Binger was to leave Kong about the middle of March, and to turn northward to Bobodiulasu, where he was to arrive on the 6th or 7th of April. Thence his route lay to Wongodugu. From Wongodugu he intended to make his way to the Niger at Say, then to return to Kong by way of Sansanne-Mango, Yendi, Salaga, and Ngottogo. From Kong, finally, he wanted to reach the coast, passing through the capital of Buntuku, the position of which was not accurately determined by the English Capt. Lonsdale, who visited it in 1883.

It is now ten months since we have had news of the enterprising traveller. From the time of his departure at Bammako, up to

the time of his arrival at Kong, — a period of six months and a half, — he must have traversed from seven hundred to a thousand miles. Judging from this fact, it would take him at least a year to complete his proposed tour from the city of Kong, and his return to the same. We must not be surprised at not having heard from him: that may be due to a lack of opportunity for sending messages.

Having given this description of the journey of Capt. Binger, we can but wish that it may terminate as well as it has begun.

GUSTAVE EIFFEL.

BEFORE proceeding to speak of the Eiffel Tower in detail, *Engineering*, in its issue of May 3, in which is a noteworthy survey of the opening Paris Exhibition, takes occasion to say a few words about Gustave Eiffel and his works. Born at Dijon in 1832, he passed brilliantly through the Ecole Centrale, and commenced the active pursuit of his profession in 1855. One of his first works was the completion of the foundations of the great railway-bridge of Bordeaux by means of compressed air, — a system then but little known in France. After this work, M. Eiffel constructed a large bridge over the Nive at Bayonne, and two others at Capdenac and at Florac.

In 1867 he was intrusted by M. Krantz, the commissioner-general of the Paris Exhibition of that year, with the task of checking experimentally the calculations made for the large buildings. In 1868 he constructed, under the direction of M. de Nordling, engineer of the Orleans Company, the viaducts with iron piers, upon the line between Commentry and Gannat. It was in these viaducts that he first employed the system consistently followed by him afterwards, of wrought-iron braced structures, instead of cast-iron columns or masonry piers. A little later he introduced, with great success, a system of launching bridges from their site of erection on the ground across the piers previously built to receive them. His first attempt in this direction was in 1869, with the Sioule viaducts, followed by another at Vianna, in Portugal, where iron girders more than 1,800 feet in length were launched into position. Then came the viaduct of Tardes, near Montluçon, which was launched at a height of 328 feet above the ground, over piers 340 feet apart.

M. Eiffel was the first among French engineers to employ the system of erecting bridges of great span without scaffolding, by building out the structure piece by piece. His first work of this class was at Cubzac, near Bordeaux, where he crossed a river with a bridge 236 feet span without any staging. At Tan-an, in Cochin China, he erected in a similar way a bridge of 262 feet span. Of arched bridges built in the same manner, the most important, until it was surpassed by the viaduct of Garabit, was the great bridge over the Douro, at Oporto, the central span of which is 534 feet, and the rise of arch 138 feet, the height of rails above the water-level being no less than 200 feet. But he surpassed himself in the Garabit viaduct, where an arch 541 feet span crosses the torrent of the Truyère 400 feet above it. Among the other great engineering works carried out by M. Eiffel must be mentioned the Pesth railway-station; the Szegedin bridge; the principal façade of the Paris Exhibition of 1878; and the dome of the Observatory at Nice, 75 feet in diameter, and weighing more than 100 tons, which floats within a circular trough, so that the effort required to move it is almost inappreciable. Scarcely less remarkable as an engineering work, and as a triumph of the founder's art, is the gigantic statue of Liberty, modelled by Bartholdi, and presented by France to the United States, where it now stands lighting the entrance to the harbor of New York.

The great series of locks which were to have formed a sort of giant staircase for the passage of ships across the Isthmus of Panama was elaborated as to design, and considerably advanced as to execution, when the great work collapsed. From the foregoing rapid sketch, it will be seen that few engineering constructors have carried out so many important and original works as M. Eiffel; and the success which has uniformly attended him was a guaranty for the stability and beauty of his latest effort, the Column of the Republic, and his own monument.

Of course, the idea of a tower of gigantic height is not a new

one. Not to mention the efforts of the early engineers which had the unexpected result of inventing foreign languages, there are three better authenticated and more recent proposals than the instance in which the sons of men said, "Go to, let us build us a tower whose top may reach unto heaven, and let us make us a name." The earliest was that of the splendid but eccentric genius Trevithick in 1833; then came the proposal of the well-known American engineers, Messrs. Clarke & Reeves, who offered to construct for the Philadelphia Exhibition, in 1876, a tower, 1,000 feet in height, of wrought iron, and about 150 feet in diameter at the base. Finally, in 1881, a M. Sebillot proposed to light Paris electrically by a 1,000-foot tower.

Excepting the American project, none of these schemes had any practical value, but the proposal of Trevithick is worth referring to here. He suggested, in a letter published in the *Morning Herald* of July 11, 1832, that the passing of the Reform Bill should be commemorated by a gigantic tower made of cast iron, 1,000 feet in height, 100 feet in diameter at the base, and 12 feet in diameter at the top. It was to be set upon a stone plinth 60 feet high, and was to have a capital 50 feet in diameter, supporting a colossal statue. The shape was to be that of a cone, and an internal cylinder 10 feet in diameter was to run from the ground to the top of the structure. Trevithick proposed that the tower should be composed of 1,500 symmetrical segments, with internal flanges around their edges for bolting them together. Each segment was to be pierced with a large circular opening for lessening the weight and reducing the wind-pressure. The total weight was to be about 6,000 tons, and each of the cast-iron panels was to weigh about 3 tons. The contract price offered for the castings was £7 per ton, the total estimate of expense was under £80,000, and Trevithick undertook the erection of the column in a period not to exceed six months. Passengers were to be raised to the top of the tower in the central cylinder, which was to be fitted with a piston providing accommodation on its upper surface for twenty-five persons; and the piston was to be raised from the bottom to the top by compressed air forced into the cylinder, and controlled by suitable valves. Fortunately for the memory of Trevithick, this scheme remained upon paper.

The Eiffel Tower is the natural development of the class of work upon which its constructor has been occupied for so many years. It was the direct outcome of a series of investigations undertaken by M. Eiffel in 1885, with a view of ascertaining the extreme limits to which the metallic piers of viaducts could be pushed with safety, this special line of investigation having reference to a proposed bridge with piers 400 feet in height and 140 feet of base. The idea of the great tower followed, preliminary plans were prepared, and calculations made by two of M. Eiffel's principal engineers, — MM. Nouguier and Koechlin, — and by M. Sauvestre, architect. Naturally, the leading principle followed was that adopted by M. Eiffel in all his lofty structures; namely, to give to the angles of the tower such a curve that it should be capable of resisting the transverse effects of wind-pressures, without necessitating the connection of the members forming these angles, by diagonal bracing. The Eiffel Tower, therefore, consists essentially of a pyramid composed of four great curved columns, independent of each other, and connected together only by belts of girders at the different stories, until the columns unite towards the top of the tower, where they are connected by ordinary bracing. Iron, and not steel, was used in the construction throughout.

MENTAL SCIENCE.

Psychic Cures.

OUR first record of the practitioners of the healing art describes them as invested with the priestly function, thus making the cure of physical ills a result of intellectual and religious influence. When reading the records of the past in the light of modern knowledge, we can trace almost at every point the very marked influence of mental states in the cure, sometimes described as miraculous, of disease. The reputed drugs altogether harmless, or of the physician who gave the drug, is often due to the successful action of the patient's own belief upon his susceptible system. And quite as truly are the wonderful cases of the infliction of ills by

secret curses and superstitious rites to be accounted for upon the same principle.

In more recent times the success of a host of quack remedies, supported by quasi-scientific proofs, is to be referred to the same influence of mind upon body. The existence of such influence, and its great power for good or ill, is fully admitted by modern science; its practical application has, however, been left almost exclusively to charlatans and empirics. Naturally the physician has encountered the general fact of mental influence, and more or less unconsciously profited by its benefits; but the outspoken recognition of psychic states upon physical ills has been rare, owing to the endangering of one's reputation to which such a step would lead. The result has been that a special sect, ignorant of all rational physiology, has taken up the valuable kernel of truth, and surrounded it with an enormous shell of fantastic doctrines, semi-religious and altogether unscientific, in which the original kernel is warped quite out of recognition.

In recent years the question has assumed a more scientific aspect, owing to the light shed upon it by the researches in hypnotism. In this condition, in which suggestions are obeyed with abnormal readiness, it has been shown that functions ordinarily beyond voluntary control can be influenced, and thus a way be opened up for acting upon disturbed functions and diseased conditions. With a sensitive subject, a burn can be suggested at the spot where a coin touches the skin, and the inflammation, the scar, and all, will result. Further, if the suggestion be given that of two wounds the one will heal very quickly and the other slowly, one may find the inflammation almost entirely gone from the one on the following day, while on the other it will be evident for days or even weeks. If nature's process can thus be hastened or retarded, though in a somewhat abnormal condition it is true, why should it not be possible to systematically utilize this power in the case of real ills? Isolated examples of such attempts can be pointed out. Dr. Esdaile in India performed many operations in which hypnotism was the only anæsthetic used, and Dr. Liebault of Nancy has for many years been treating his patients by hypnotic suggestion whenever it seemed desirable. The writer has recently had an opportunity to witness the well-systematized procedures of two physicians at Amsterdam — Drs. Van Renterghem and Van Eeden — in the same direction. These physicians regard hypnotism as a form of sleep very variable in intensity, and passing imperceptibly into a normal sleep. They find a very large percentage (about 75 per cent or more) partially susceptible to its influence, and make no claim beyond the power to appeal by this means to natural restorative processes where the usual means of treatment have been of little avail. The process is a gradual one, and the suggestion must be very frequently repeated before a complete cure is effected. There is no element of the mysterious about their proceedings, but simply a methodical attempt to test the powers of mental influence upon physical ills.

As just noticed, they recognize different degrees of hypnotic sleep, and regard the memory that the subject retains of what has been done during the hypnotic condition as a convenient point of distinction between them. In the lightest sleep the patient remains fully conscious of what has been going on, and can give an accurate account of it. When the sleep is deeper, his remembrance is vague, and hints must be given in order to recall the events. In the deeper sleep all recollection is gone. Of 178 persons, only 7 could not be hypnotized, and 79 were thrown into a deep sleep. The procedure is very simple, and depends entirely upon the acceptance of a suggestion. The eyelids are closed and held for a moment, the patient being told to go to sleep; or the patient fixates the physician's eye for a moment, with the same result. A breath upon the eyelids, or touch upon the nose, easily awakens the sleeper. While in this condition, the suggestions are given that the pain will be gone, that the power to move a paralyzed limb will return, that sight or hearing will improve, that hallucinations will not recur, and so on, to suit the requirements of each case. In cases of paralysis the limbs are moved for the patient, gradually extending the range of the movement, and suggesting the same motions to be effected voluntarily by the patient. In cases of partial blindness, exercises in seeing and distinguishing different objects are made under hypnotic suggestion. In brief, each case

must be treated individually; and it requires the utmost tact, aided by a pleasing and impressive manner, to accomplish the best results. To the effects of such indirect suggestions, every candid physician will testify.

As to the time of cure, this depends upon the special malady and the individual. Sometimes a single suggestion will suddenly effect an almost complete cure, while in other cases the progress is very slow. The more gradual cures are to be preferred as being more in harmony with nature's methods. The kinds of disease most readily yielding to this treatment at once suggest the processes here involved. Hysterical affections make up a considerable portion of the cases treated; and in these the combined psycho-physiological disturbance is more mental than physical. But paralysis, rheumatic troubles, palpitations of the heart, digestive irregularities, and nearly all the ills that flesh is heir to, are found upon the list of successfully treated cases. They are all, however, functional troubles. In cases of organic trouble it is evident that restoration is not more possible by this method than by another. The difficulty is, that severe functional troubles may take the appearance of being organic, especially in cases of complicated disease. It must be admitted, however, that the benefits of hypnotic treatment have a much wider extent than what are generally understood by hysterical affections. Of 162 cases treated, 91 are regarded as restored to health, 46 have improved, and only 25 have been treated without avail. The main point at issue will probably be the permanence of such cures. The question has not been studied sufficiently long to admit of a positive answer, but the proper basis for a conclusive verdict is rapidly being accumulated. As far as the evidence goes, it points to as large a percentage of permanent cures as is effected by treatment by any other method. Cases are not unknown in which, after all skill has been applied, a sudden shock or accident has effected a complete and permanent restoration. The sudden cures of hypnotism may be regarded as affiliated with this class. The far more numerous gradual cures are naturally subject to relapses, and repeated suggestion is necessary to continue the progress.

Another point that will not fail to be raised is the danger incident to such methods. The dangers are real, and of many kinds; but they are all such as, in the hands of a skilful physician, are reduced to a minimum. The avoidance of unpleasant suggestions, an easy awakening from the sleep, the suggestion that no one else but the physician can hypnotize the patient, — all contribute to a successful result.

The entire question is one that the future must decide; but it should be recognized that attempts are now in progress to clear this very fertile field of the weeds that have grown upon it, and cultivate it assiduously for the advancement of science and the benefit of mankind.

BOOK-REVIEWS.

The Primitive Family in its Origin and Development. By C. N. STARCKE. (International Scientific Series.) New York, Appleton. 12°. \$1.75.

THE object of this work is to set forth the nature of the family as it exists in the most primitive form known to us, and, so far as possible, to trace its origin and the course of its development. To accomplish this end, the use of the comparative method is of course essential; and hence the author takes us over the whole field of savage life, and gathers proofs and illustrations from every quarter of the globe. Mr. Starcke's views on many of the subjects treated are opposed to those hitherto prevalent, and his book is largely a polemic against the writers with whom he disagrees. Thus it has been quite commonly held that in many tribes, if not in all, the earliest state of society was one of promiscuous intercourse between the sexes, and evidence of this has been believed to exist in the widely diffused custom of reckoning descent through the mother alone. Mr. Starcke denies all this, and maintains that "the social life of man begins with the partially aquatic family, and the family group which is ruled by the father in virtue of his physical superiority. . . . Clans are subsequently formed which, as their internal cohesion increases, gradually pass from the paternal

to the maternal line of descent" (p. 53). His account, however, of the way in which the maternal line originated is very obscure. Again, it has been a common opinion that the clan was developed out of the family, and the tribe out of the clan, so that the origin of government is to be traced back to the patriarchal rule of the father over his family. This also Mr. Starcke denies, holding that "the primitive organization of the clan is derived from that of the tribe, and not of the family. . . . The clan differed from the tribe as a part from the whole. . . . The family, on the other hand, is an altogether independent formation which flourishes within the tribe or clan. . . . The family does not develop into a clan" (pp. 276, 277). Marriage, in Mr. Starcke's view, arose, not from the sexual instinct nor from the affections, but from the desire of the man to have somebody to keep house for him. Many usages connected with the family are to be explained, in our author's opinion, by legal regulations. Thus he thinks that the names used to designate the various degrees of relationship were "the faithful reflection of the juridical relations which arose between the nearest kinsfolk of each tribe. Individuals who were, according to the legal point, on the same level with the speaker, received the same designation" (p. 207). In the same way he endeavors to account for exogamy and endogamy by legal regulations; but unfortunately he fails to tell us why the legal relations of persons came to be such as they were, rather than otherwise.

Such are Mr. Starcke's views on some of the leading topics discussed; and it is evident that they furnish material for considerable controversy. We shall not undertake any criticism of them, however, at the present time, but content ourselves with simply setting them forth. But there are certain literary faults in the book which can hardly be passed over. One of these is the obscurity with which some of the author's views are stated, which leaves the reader in doubt as to what he is trying to prove. Another fault, especially in the earlier chapters, is the excessive amount of detail, which makes us lose sight of the point under discussion in the mass of disconnected facts. In spite of these defects, however, the book will be interesting to all students of primitive society, and none the less so, perhaps, on account of its controversial character.

Hygienic Physiology, with Special Reference to the Use of Alcoholic Drinks and Narcotics. By JOEL DORMAN STEELE, Ph.D. New York and Chicago, Barnes. 12°. \$1.

THIS is a revised edition of the well-known "Fourteen Weeks in Human Physiology," and therefore needs no special comment. The subject of disinfectants occupies but a single page, and is unfortunately not in accord with the best knowledge that we possess on this important subject. The published reports of the American Public Health Association furnish more reliable information as to methods of disinfection, and we are surprised that in the preparation of this volume they were not consulted, rather than adopting the recommendations of the National Board of Health, which were reliable ten years ago, but are, so far as we know, not followed by any sanitary authorities at the present day.

A Hand-Book of Cryptogamic Botany. By ALFRED W. BENNETT and GEORGE MURRAY. London and New York, Longmans, Green, & Co. 12°. \$5.

THAT a text-book on this subject is greatly needed will be readily understood when the statement is made that no general hand-book on cryptogamic botany has appeared in the English language since that of Berkeley in 1857. As the authors of the present volume truly say, since then this department of botanical science has gone through little less than a revolution. Not only has the number of known forms increased enormously, but additions of great importance have been made to our knowledge of structure by the use of the microscope, and to the genetic connection of different forms by the careful following-out of the life-history of particular species. The main object of the present work is to bring within the reach of botanists, and of the public generally who are interested in the study of nature, an acquaintance with the present state of knowledge in this branch of science. The authors recognize that the question of terminology is one of the greatest stum-

bling-blocks to the student of cryptogamy; and they have, commendably we think, simplified the scientific terms whenever possible. Thus they employ throughout the volume "sporangium," "archegonium," "antheridium," "cœnobe," "sclerote," "epiderm," etc., in place of the Latin and Greek forms hitherto used. The arrangement of the subject-matter is admirable, and the illustrations are sufficiently abundant and well executed for the purpose for which they were designed. Of the type and paper, and the general execution of the work, too much cannot be said in the way of praise.

Outlines of Lessons in Botany, for the Use of Teachers, or Mothers studying with their Children. By JANE H. NEWELL. Boston, Ginn. 16°.

THESE lessons are suitable for children of twelve years and upward, and are arranged after the plan of Gray's "First Lessons" and "How Plants Grow," and are intended to be used in connection with either of those books. The author's aim has been to prepare such outlines as will aid teachers in fostering in their pupils the power of observation and clear expression. The volume deals with plants and their uses as food, clothing, fuel, and in the purification of the air. Directions are given for the raising of the morning-glory, sunflower, bean, and pea in the schoolroom or at home, and what to observe in the roots, stem, buds, branches, and leaves of these and other plants. Twenty-five well-drawn figures aid the text very materially.

AMONG THE PUBLISHERS.

TICKNOR & CO. have in preparation Pfeiffer's "American Mansions," a series of designs by Mr. Carl Pfeiffer for dwelling-houses of various classes, with all their details, both decorative and constructive, carefully worked out.

— Charles Scribner's Sons will publish shortly the second volume of Professor Charles W. Shields' "Philosophia Ultima;" and "Progress of Religious Freedom as shown in the History of the Toleration Acts," by the Rev. Dr. Philip Schaff.

— Roberts Brothers published on the 14th the second division of Rénan's "History of the People of Israel," from the reign of David up to the capture of Samaria.

— D. Appleton & Co. have ready "The Primitive Family in its Origin and Development," by Professor C. N. Starcke of the Copenhagen University, which forms Vol. LXV. of the International Scientific Series; Part V. of Vol. III. of Roscoe and Schorlemmer's "Treatise on Chemistry," covering "The Chemistry of Hydrocarbons and their Derivatives;" and "How to Study Geography," by Francis W. Parker, which forms Vol. X. of the International Education Series. They have in preparation "An Epitome of Herbert Spencer's Synthetic Philosophy;" "Stellar Evolution," by Dr. James Croll; "European Schools in 1888," by Dr. L. R. Klemm; "A Dictionary of Terms in Art;" and the annual volume for 1888 of "Appletons' Annual Cyclopædia."

— The J. B. Lippincott Company will publish next week, by subscription, the first volume of "The Cyclopædia of the Diseases of Children," by American, British, and Canadian authors, edited by John M. Keating, M.D.

— Professor John F. Genung of Amherst College has published through Messrs. Ginn & Co. of Boston a "Handbook of Rhetorical Analysis," intended to be a companion to his treatise on rhetoric. It consists of extracts from some twenty English writers, mostly of the present century, with notes and questions designed to lead the student to a proper appreciation of the qualities of style and thought which they exhibit. Most of the extracts are excellent, some of them being chosen for their style, and others for the depth of thought or power of invention shown in them. The editor's notes and questions are very numerous, and sometimes very suggestive, and we should think the volume would be quite useful to students of style and composition.

— As evidence of the wide interest that has been taken during the past year in the contents of *The Forum*, is cited the fact that in that period more than three thousand editorial articles suggested by *Forum* articles were printed in American and English papers.

—Gebbie & Co., Philadelphia, will shortly publish "Half a Century of Music in England," by the late Francis Hueffer. The book was finished just before the death of the popular author.

—D. C. Heath & Co. will soon publish the "Public School Music Course," by Charles E. Whiting, formerly teacher of music in the Boston public schools. It will be a series of six graded music-readers, adapted to all the primary and grammar-school

grades, and intended to lead up to the author's "High School Music Reader." Time-names, breathing-marks, etc., are included, and every thing necessary for a complete music course. There is a large number of one, two, three, and four part songs, selected from the best German, English, French, and American composers. Each of the first three numbers has, besides the songs, over three hundred exercises. The first two books will be illustrated.

Publications received at Editor's Office,
May 6-II.

- AMERICAN Water-Works, The Manual of, 1888. New York, Engineering News 611 p. 8°.
CASEY, J. A Treatise on Spherical Trigonometry, and its Application to Geodesy and Astronomy. London and New York, Longmans, Green, & Co. 160 p. 12°. \$1.50.
CONNECTICUT Agricultural Experiment Station, Annual Report of, for 1889. Part I. New Haven, State. 48 p. 8°.
CONNECTICUT State Board of Health, Eleventh Annual Report of the, for the Year ending Nov. 30, 1888; with the Registration Report for 1887, relating to Births, Marriages, Deaths and Divorces. New Haven, State. 500 p. 8°.
GENUNG, J. F. Handbook of Rhetorical Analysis. Boston, Ginn. 306 p. 12°. \$1.25.
GOULD, J. The Birds of Great Britain. Part XIV. London and Manchester, H. Sotheran & Co. Colored plates. f°. 63 35.
— A Monograph of the Trochilidae or Humming Birds. Part XXI. London and Manchester, H. Sotheran & Co. Colored plates. f°. 63 35.
— The Birds of New Guinea and the Adjacent Papuan Islands, including any New Species that may be discovered in Australia. Part XXII. London and Manchester, H. Sotheran & Co. Colored plates. f°. 63 35.
HOG Cholera: its History, Nature, and Treatment, as determined by the Inquiries and Investigations of the Bureau of Animal Industry. Washington, Government. 103 p. 8°.
KLEIN, E. The Bacteria in Asiatic Cholera. London and New York, Macmillan. 179 p. 16°. \$1.25.
METEOROLOGY, Bibliography of. Part I. Temperature. Ed. by Oliver L. Fassig. Washington, Signal Office. 381 p. 8°.
MINNESOTA, The Geological and Natural History Survey of. Sixteenth Annual Report for the Year 1887. St. Paul, State. 504 p. 8°.
NEW YORK Meteorological Observatory of the Department of Public Parks, Central Park, New York City. Report of, for the Year 1889. New York, Daniel Draper, Ph D. 8°.
PIERSON, E. DeL. The Black Ball. Chicago, New York, and San Francisco, Belford, Clarke, & Co. 223 p. 12°. 50 cents.
ROOSEVELT, C. The Mode of Protecting Domestic Industries; The Science of Government, founded on Natural Law; Paradox of Political Economy. New York, The Author. 125 p. 8°.
STARCKE, C. N. The Primitive Family in its Origin and Development. (Internat. Scient. Ser.) New York, Appleton. 315 p. 12°. \$1.75.
TAYLOR, J. E. The Playtime Naturalist. New York, Appleton. 287 p. 12°. \$1.50.

Correspondence solicited with parties seeking publishers for scientific books.

N. D. C. HODGES,
Publisher of Science,
47 Lafayette Place,
New York.

Old and Rare Books.

One Million Magazines. Back numbers, vols. and sets—old and new, Foreign and American. CATALOGUE UPON APPLICATION.
A. S. CLARK,
34 Park Row, New York City.

BACK NUMBERS and complete sets of leading Magazines. *Rates low.* AM. MAG. EXCHANGE, Schoharie, N.Y.

H. WILLIAMS,
Dealer in Old Magazines, Reviews, &c. Scientific periodicals a specialty. 39 Macdougal St., N.Y.

Just Published.

1 Vol., 400 Pages, 30 Full-page Plates, and 75 Illustrations in Text. Price \$6.00.

**Sewerage
and Land
Drainage,**

BY

GEORGE E. WARING, JR.,

Honorary Member of the Royal Institute of Engineers (Holland); Member of the Institution of Civil Engineers (England); Fellow of the Sanitary Institute of Great Britain; Corresponding Member of the American Institute of Architects;

CONSULTING ENGINEER
For Works of Sanitary and Agricultural Drainage.

D. VAN NOSTRAND COMPANY,
PUBLISHERS,

23 Murray and 27 Warren Streets, New York.



GAUSS AND WEBER, who proposed and employed the system of absolute measurements, early in the present century.

**The Electrical Articles
IN SCRIBNER'S MAGAZINE**



are begun in The June Number, by Prof. C. F. Brackett of Princeton, by a paper entitled "Electricity in the Service of Man," setting forth in a clear, precise way, some of the common methods by which the more important electrical phenomena are produced. The illustrations are copious and beautiful. Other articles in the series will follow (*i.e.*), "Electricity in Modern Telegraphy," by Charles L. Buckingham, chief electrical expert of Western Union Tel. Co.; "Electricity in Lighting," by Henry Morton, President Stevens' Institute; "Electricity in the Household," by A. E. Kennelly, chief electrician in laboratory of Thomas A. Edison; "Electricity in relation to the Human Body," by Dr. M. Allen Starr; "Electricity in Warfare," by Lieut. W. S. Hughes, U.S.N.; "Electricity in Large Industries," etc., etc., etc.

This will be one of the most interesting and valuable series of articles ever attempted. Nothing will be left undone to make it surpass in popularity the "Railroad Series," begun about a year ago in Scribner's.

Among other valuable Articles in The June Scribner are one on "Building Loan Associations," and another on "Striped Bass Fishing."

Price 25 cents a number, \$3 00 a year. Begin your subscription with June No., which contains the first of the electrical articles.

CHARLES SCRIBNER'S SONS, Publishers.

743-745 BROADWAY, NEW YORK.

—The question of what to cook for young children, and how to cook it, is given considerable prominence in the May number of *Babyhood*, which contains an article on the subject, the first of a series. The number contains also an article on constipation, by Dr. John Dorning, which is designed to answer the surprisingly large number of questions concerning this widespread trouble of infancy that are constantly being addressed to the medical editor of *Babyhood*. A new feature of decided educational value is the introduction of a department of "Botany for the Little Ones," showing how the study of plant-life may be rendered fascinating to the youngest children. The mothers themselves contribute to the "Parliament" an unusually large number of interesting letters on such topics as "Dress Reform and Physical Improvement," "Kill or Cure Methods," "Ways and Means at the Table," "An Effectual Method of Subduing Restlessness," "Pastimes in Travelling with Children," etc.

— "People I've Smiled With, or, Recollections of a Merry Little Life," is the happy title of Marshall P. Wilder's forthcoming book which Messrs. Cassell & Co. will publish within a few weeks. Everybody knows Marshall Wilder, and everybody likes him and admires the plucky fight he has made against physical odds. He gets an unusual amount of pleasure out of life, and gives a great deal to other people too. He has a sunny disposition, and he knows how to make people laugh. The consequence is, that he is in constant demand for public halls and private houses; and he has not only made a lot of money, but he has made hosts of friends. In this country he counts among them the late Gen. Grant, Ex-President Cleveland, the late H. W. Beecher, Gen. Sherman, James G. Blaine, Gen. Horace Porter, Chauncey M. Depew, and scores of others. In England he hobnobbed with the "swells" from the Prince of Wales down the list. All of these he serves up in his kindly way as "People I've Smiled With."

—Early in June, Longmans, Green, & Co. will issue in New York the first number of *The New Review*, an English monthly started by Mr. Archibald Grove, a young Oxford man. In the strength of its articles and in the reputation of its contributors, it is to rival the *Nineteenth Century*, while its low price will put it within reach of a far wider public. Three Americans—Lady Randolph Churchill, Mr. Henry George, and Mr. Henry James—are among the contributors to the first number.

—The *Nineteenth Century* for May (New York, Leonard Scott Publication Company, 29 Park Row) more than retains the high place this review has made for itself. The reader will doubtless turn first to Dr. Wace's reply to Professor Huxley's rejoinder on agnosticism in the April number, in which he emphasizes the position he took in his previous paper, and takes Professor Huxley to task for some of his misstatements. The Bishop of Peterborough also has a brief word to say on the same subject. Lord Armstrong reviews the "New Naval Programme," recently adopted in England, which he considers of a more systematic and business-like character than any similar document previously emanating from the admiralty. Professor Edward Dicey has a paper on the "Lesson of Birmingham," in which he reviews the meaning of the late election in that city. The Countess of Jersey has a pleasant paper on the "Hindu at Home," describing the daily life of the Hindus. Miss Clementina Black summarizes a remarkable speech by a working-woman at the formation of a trades-union in Liverpool. Professor H. Geffcken, who achieved notoriety in connection with the publication of the Emperor Frederick's diary, and who has the subject of special persecution by Prince Bismarck, contributes a paper on "Church and State in Germany," in which he makes an eloquent plea for the restoration of the independence of the Evangelical Church. An especially timely paper is a story of a visit by Edward Clifford to Father Damien and the lepers, whose recent death has concentrated public attention upon his heroic work in the Sandwich Islands. Frederick Marshall writes on "Society and Democracy in France," depicting some of the later changes in French social growth. Frederick Greenwood discusses "Misery in Great Cities," comparing the relative advantages of city and country life, and suggesting remedies for the alleviation of the condition of the working-people. Frederic Harrison reviews the results of the Parnell trial as affecting the cause of home rule, which is, he

says, "by far the largest, most momentous, and most complex question which has ever divided England since the Revolution." The number concludes with a paper by Mr. Gladstone, entitled "Italy in 1888-89," in which he records the observations made in his recent visit to that country. Mr. Gladstone had not visited Naples for twenty-nine years, and is therefore able to note astonishing changes. He reviews the results of the Italian revolution, and considers the present condition of the country both internally and as a European power.

—When Mr. Bright had to make a great speech, says the *Contemporary Review*, he brooded over it day after day, but he did not care to don all his preparation at his desk or in solitude. As arguments and illustrations occurred to him, he liked to try their effect by talking them over with his friends; and when he was at home, if nobody else was within reach, he talked them over with his gardener. The speech took shape in conversation. Then he made the notes which he intended to use when the speech was delivered. He gave an account of these notes in a letter, in which he said, "As to modes of preparation for speech-making, it seems to me that every man would readily discover what suits him best. To write speeches, and then to commit them to memory is, as you term it, a double slavery, which I could not bear. To speak without preparation, especially on great and solemn topics, is rashness, and cannot be recommended. When I intend to speak on any thing that seems to me important, I consider what it is that I wish to impress upon my audience. I do not write my facts or my arguments, but make notes on two or three or four slips of paper, giving the line of argument, and the facts, as they occur to my mind, and I leave the words to come at call while I am speaking. There are occasionally short passages which, for accuracy, I may write down, as sometimes also, almost invariably, the concluding words or sentences may be written. This is very nearly all I can say on this question. The advantage of this plan is, that, while it leaves a certain and sufficient freedom to the speaker, it keeps him within the main lines of the original plan upon which the speech was framed; and what he says, therefore, is more likely to be compact, and not wandering and diffuse." It was his habit, when he spoke on the platform, to place his notes on the brim of his hat, which stood on the table before him. They were written on half-sheets of note-paper. Extracts of more than three or four lines in length which he intended to quote in support of his statements were usually written on similar half-sheets, separately numbered, and were carefully placed on the table by the side of the hat. His annual speeches to his constituents rarely extended over less than an hour; and they as rarely exceeded an hour and five minutes. But the sheets of notes varied greatly in number: sometimes he had only four or five, sometimes he had eight or nine, and I think that occasionally he had still more.

—Lee & Shepard have just ready "Incidents of a Collector's Rambles," by Sherman F. Denton of the Smithsonian Institution, — a volume of travel by a keen observer of nature, and a graphic story-teller, illustrated with views and pictures of strange people and things seen in the far-off countries which he has visited; "Burgoyne's Invasion of 1777," with an outline sketch of the American invasion of Canada, 1775-76, by Samuel Adams Drake, with maps, portrait, and illustrations,—the first of a contemplated series of decisive events in American history, designed as a textbook for supplementary reading in schools and for general reading; "Every-Day Business," notes on its practical details, arranged for young people by M. S. Emery; and "Observation Lessons," — a manual for teachers, presenting practical methods of teaching elementary science to the young, — by Louisa P. Hopkins, of Boston public schools.

—Little, Brown, & Co. have just ready the American edition of "A Complete Concordance to the Poems and Songs of Robert Burns," compiled and edited by J. B. Reid.

—*Harper's Weekly* of last week contains an eight-page supplement with an article on "Prehistoric Arizona," by Col. R. J. Hinton, illustrated by Harry Fenn.

—D. Appleton & Co will publish early in the summer, "Days Out of Doors," by Dr. Charles C. Abbott, whose "Naturalist's Rambles about Home" is so well known.

GUARANTY INVESTMENT COMPANY

CAPITAL \$250,000.

Offices: Atchison, Kan. 191 Broadway, New York. 222 Walnut St., Phila.

Hon. ALBERT H. HORTON (Chief Justice, Kansas Supreme Court), Topeka, Kan., Pres't.

7% Guaranteed Farm Mortgages 7%

The Guarantee Investment Company makes loans upon fertile farms in the choicest portions of Kansas and Nebraska and has adopted the policy of sending a Committee of its Investors each year to examine its loans and methods of business.

The Committee this year consisted of PROF. A. H. BERLIN, Principal of the High School Montrose, Pa., and MAJ. THEODORE L. POOLE, Ex-U. S. Pension Agent, Syracuse, N. Y. Both of these gentlemen are persons of the highest character and have the confidence of the Communities in which they reside.

The Committee has recently returned and has made a very interesting Report upon the general development of Kansas and Nebraska as well as the business of the Company. The Company will be glad to send this Report to any address.

The following names are taken from the long list of Investors in our Mortgages:

(See if Some Friend of Yours is not in the List.)

William A. Cauldwell, 59 Liberty St., N.Y.
Palmer Cox, 658 Broadway, N.Y.
Rev. Jos. H. Rylance, D.D., 11 Livingston Place, N.Y.
Rev. Brady E. Backus, D.D., 360 West 28th St., N.Y.
Rev. R. M. Sommerville, 126 West 45th St., N.Y.
Dr. Robert A. Murray, 235 West 23d St., N.Y.
Dr. James P. Tuttle, 136 West 41st St., N.Y.
H. Edwards Rowland, 218 Fulton St., N.Y.
Irving H. Tift, Esq., 271 Broadway, N.Y.
Prof. D. G. Eaton, 55 Pineapple St., Brooklyn, N.Y.
Dr. F. P. Thwing, 156 St. Marks Ave., Brooklyn, N.Y.
Dr. C. C. Miles, Greenport, N.Y.
John V. N. Bergen, Port Jefferson, N.Y.
Benj. W. Stilwell, Yonkers N.Y.

R. C. Coleman, Goshen, N.Y.
Mrs. Samuel Carlisle, Newburg, N.Y.
Dr. C. C. Bartholomew, Ogdensburg, N.Y.
Rev. Nelson Millard, D.D., Rochester, N.Y.
Rev. Horace G. Hinsdale, D.D., Princeton, N.J.
Dr. Charles M. Howe, Passaic, N.J.
George A. Skinner, 5 Railroad Place, Newark, N.J.
Dr. Edwin M. Howe, 85 Halsey St., Newark, N.J.
Dr. H. G. Buckingham, Clayton, N.J.
Dr. Martin Cole, Jr., Hainesville, N.J.
Mortgage Trust Co. of Pa., Philadelphia, Pa.
Miss Mary Miller, 1230 Spruce St., Philadelphia, Pa.
Henry D. Biddle, 311½ Walnut St., Philadelphia, Pa.

Dr. Calvin C. Halsey, Montrose, Pa.
Rev. William Baldwin, Great Bend, Pa.
Gen. William Lilly, Mauch Chunk, Pa.
Second Nat. Bank, Mauch Chunk, Pa.
Enos E. Thatcher, West Chester, Pa.
Mrs. Townsend Poore, Scranton, Pa.
Rev. Burdett Hart, D.D., New Haven, Conn.
Dr. Frank H. Wheeler, New Haven, Conn.
Charles R. Christy, Stamford, Conn.
Mrs. Catharine P. Fuller, Woodmont, Conn.
Miss Jessie Henderson, Lenox, Mass.
Dr. M. J. Halloran, Worcester, Mass.
Albert Walker, Bennington, Vt.

Address for Report and Monthly Bulletin

HENRY A. RILEY, General Eastern Manager, 191 Broadway, N.Y.

A NEW MAGAZINE—THE SWISS CROSS
Devoted to spreading a love of nature among the people. Edited by HARLAN H. BALLARD, President of the Agassiz Association, and succeeding *St. Nicholas* as the official magazine of that body. \$1.50 a year. Sample copy 10 cents. or 25 cents for trial subscription for 3 months.
N. D. C. HODGES, PUBLISHER.
Mention this magazine 47 Lafayette Place, New York.

Original, Simple, Natural, Suggestive, Comprehensive, Educational and helpful entirely apart from the memory phase of the subject. JOURNAL OF EDUCATION

Memory SHEDD'S NATURAL METHOD, PRACTICAL, SCIENTIFIC.

Entirely different from any other memory method. Thoroughly taught by correspondence.

ENDORSED BY LEADING EDUCATORS.
DESCRIPTIVE PAMPHLET FREE.

MEMORY SCHOOL, 4 W. 14th STREET NEW YORK CITY.

IMPROVING THE MEMORY PICK

and facilitating the acquirement of knowledge by lectures and correspondence. Classes forming. "MEMORY and its Doctors," from Simonides to "Loisette," mailed for 10 cents.

DR. PICK, 24 Union Square, N. Y. City.

Schools.

CONNECTICUT, NEW HAVEN,
MRS. CADY'S SCHOOL FOR YOUNG LADIES.
Prepares for Smith and Wellesley, and admits to Vassar by Certificate. Circulars. Early application necessary.

INDIANA, TERRE HAUTE.
ROSE POLYTECHNIC INSTITUTE.—A School of Engineering. Well endowed, well equipped departments of Mechanical and Civil Engineering. Electricity, Chemistry, Drawing. Extensive Shops & Laboratories. Expenses low. For catalogue address T. C. Mendenhall, Pres.

NEW JERSEY, PLAINFIELD.
THE CHESTNUTS.—Parents with daughters to educate, or orphan girls with companion, may find a comfortable home, with school instruction by applying to Miss E. E. Kenyon.

SUMMER DRESSES.

We call attention to the following specialties for this week:

Black and White Striped Armure Royale, at 80 cents; regular price, \$1.15.

Black Satin Princess, \$1; regularly, \$1.25

1,000 yards Pekin Printed Foulle at 75 cents per yard, case price, \$1.25.

1,500 yards Figured Bengaline, at 75 cents, former price, \$1.25.

1,750 yards Silk Warp Henrietta, at 75 cents, usual price \$1.

These fabrics are all peculiarly adapted for use at this season of the year.

JAMES McCREERY & CO.

BROADWAY AND ELEVENTH STREET,
NEW YORK.

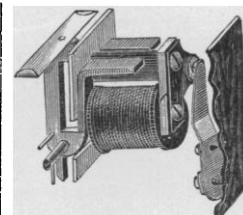


KIMBALL'S STRAIGHT CUT CIGARETTES

Unsurpassed in quality.
Used by people of refined taste.
Highest award at Brussels, 1888.
The finest smoking mixtures are of our manufacture.
Fifteen First Prize Medals.
WM. S. KIMBALL & CO.,
Rochester, N.Y.

Readers of Science

Corresponding with or visiting Advertisers, will confer a great favor by mentioning this paper.



A DROP IN THE PRICE OF

GRAVITY

DROP

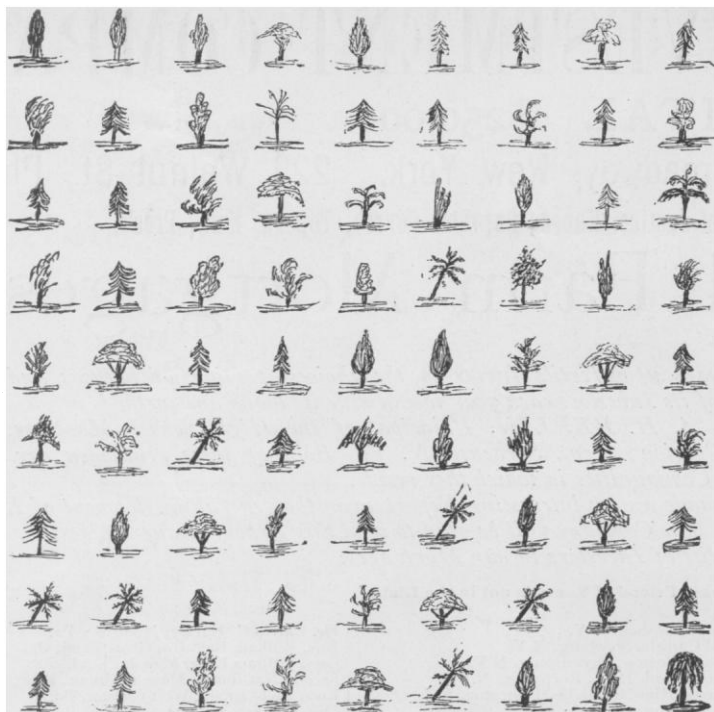
ANNUNCIATORS.

DON'T FORGET THE

DUST-PROOF BELLS.

HAZAZER & STANLEY,

32 Frankfort Street, N. Y.



Can any reader of *Science* solve the following puzzle?

A man having 81 trees to cut, arranged as above, cuts nine each day for nine days without cutting on any one day more than one tree from any line, vertical, horizontal, or diagonal.

Any one who will have the following blank filled out by a responsible Newsdealer, and mailed to us, will be allowed a three months' subscription to *Science*.

N. D. C. HODGES,
47 LAFAYETTE PLACE, NEW YORK.

1889.

To the News Company.

You may add to my regular order five copies of *SCIENCE* each week (returnable).



BRANCH AT 728 CHESTNUT ST.
PHILADELPHIA, PA.

JOHN HASTINGS = Frest.
A=R=HART = Gen Manager
JOS=TRIPP = V.Prest.

ENGRAVING FOR
ALL ILLUSTRATIVE
AND ADVERTISING
PURPOSES

67-71 PARK PLACE
NEW YORK.

SCIENCE CLUBBING RATES.

10% DISCOUNT.

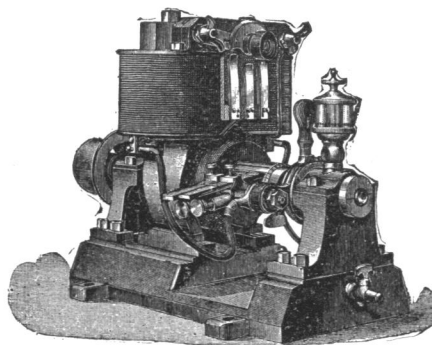
We will allow the above discount to any subscriber to *Science* or *The Swiss Cross* who will send us an order for periodicals exceeding \$10, counting each at its full price.

	Year's Subscription.	With <i>Science</i> .	With <i>The Swiss Cross</i> .
Agricultural Science.....	\$ 2.50	\$ 5.30	\$ 4.50
American Agriculturist.....	1.50	4.30	2.50
American Analyst.....	1.00	4.25	2.25
American Architect and Building News.....			
Imperial edition.....	10.00	12.80	11.00
Gelatine ".....	7.00	9.80	8.00
Regular ".....	6.00	8.80	7.00
American Garden.....	1.00	4.25	2.25
American Journal of Philology.....	3.00	5.25	4.25
American Machinist.....	2.50	5.30	4.50
American Naturalist.....	4.00	7.50	5.50
Andover Review.....	4.00	6.80	5.00
Atlantic.....	4.00	6.80	5.00
Babyhood.....	1.50	4.30	2.50
Babyland.....	1.50	3.75	1.75
Bradstreet's.....	5.00	7.80	6.00
Brain.....	6.00	9.30	4.50
Building (weekly).....	1.00	4.25	2.25
Carpentry and Building.....	4.00	6.80	5.00
Century Magazine.....	1.50	4.30	2.50
Chautauquan, The.....	3.00	5.80	4.00
Christian Union, The.....	2.50	5.30	3.50
Christian Weekly, Illustrated.....	2.00	4.80	3.00
Cosmopolitan, The.....	3.00	5.80	4.00
Critic.....	5.00	7.80	6.00
Eclectic Magazine.....	4.00	6.80	5.00
Edinburgh Review.....	3.00	5.80	4.00
Electrical World.....	3.00	5.80	4.00
Electrician and Electrical Engineer.....	3.00	5.80	4.00
Electrical Review.....	4.00	6.80	5.00
Engineering and Mining Journal.....	1.75	4.55	2.75
English Illustrated Magazine.....	4.00	6.80	5.00
Forest and Stream.....	5.00	7.80	6.00
Forum, The.....	2.00	4.80	3.00
Godey's Lady's Book.....	4.00	6.80	5.00
Harper's Bazar.....	4.00	6.80	5.00
Harper's Magazine.....	4.00	6.80	5.00
Harper's Weekly.....	2.00	4.80	3.00
Harper's Young People.....	1.00	4.25	2.25
Health and Home.....	1.00	4.25	2.25
Herald of Health.....	4.00	6.80	5.00
Illustrated London News (Amer. reprint).....	3.00	5.80	4.00
Independent, The.....	1.00	4.25	2.25
Inter Ocean, The.....	4.50	7.30	5.50
Iron Age (weekly).....	2.50	5.30	3.50
Journal of Philology (Eng.).....	3.00	5.80	4.00
Journal of Speculative Philosophy (begins with Jan. No.).....	4.00	6.80	5.00
Judge.....	5.00	7.80	6.00
L'Art.....	12.00	14.80	13.00
Life.....	3.00	5.80	4.00
Lippincott's Magazine.....	8.00	10.80	9.00
Littell's Living Age.....	1.00	4.25	2.25
Little Men and Women.....	4.00	6.80	5.00
London Quarterly.....	3.00	5.80	4.00
Macmillan's Magazine.....	5.00	7.80	6.00
Magazine of American History.....	5.00	7.80	6.00
Medical and Surgical Journal.....	2.00	4.80	3.00
Mechanical Engineer.....	1.00	4.25	2.25
Metal Worker.....	1.00	4.25	2.25
Microscope, The.....	6.00	8.80	7.00
Nature.....	3.00	5.80	4.00
New Princeton Review.....	5.00	7.80	6.00
North American Review.....	3.00	5.80	4.00
Outing.....	4.00	6.80	5.00
Overland Monthly.....	1.00	4.25	2.25
Pansy.....	3.00	5.80	4.00
Political Science Quarterly.....	5.00	7.80	6.00
Popular Science Monthly.....	1.00	4.25	2.25
Popular Science News.....	7.50	10.30	8.50
Portfolio, The.....	3.50	6.30	4.50
Practitioner.....	3.00	5.80	4.00
Public Opinion.....	5.00	7.80	6.00
Puck.....	5.00	7.80	6.00
Puck (German).....	4.00	6.80	5.00
Quarterly Review (London).....	1.00	4.25	2.25
Queries.....	2.00	4.80	3.00
Rural New-Yorker.....	3.00	5.80	4.00
St. Nicholas.....	2.50	5.30	3.50
School Journal.....	3.00	5.80	4.00
Scientific American.....	5.00	7.80	6.00
Supplement.....	2.50	5.30	3.50
Architect and Builders' edition.....	3.00	5.80	4.00
Scribner's Magazine.....	1.50	4.30	2.50
Southern Cultivator.....	1.00	4.25	2.25
Springfield Republican (weekly).....	2.00	4.80	3.00
Sunday School Times.....	1.25	4.25	2.25
Teachers' Institute.....	4.00	6.80	5.00
Texas Siftings.....	1.50	4.30	2.50
Trained Nurse.....	1.00	4.25	2.25
Treasure-Trove.....	3.00	5.80	4.00
Truth Seeker, The.....	2.40	5.20	3.40
Wide Awake.....	1.00	4.25	2.25
Young Folks' Journal.....			

N. D. C. HODGES,
47 Lafayette Place,
New York.

C. & C. ELECTRIC MOTOR COMPANY.

Electric Motors
FOR
Arc and Incandescent Cir-
cuits, Most Economical
Motor on the
Market.
Regulation Perfect.
Motors Designed for all
Power Purposes.



OFFICE and MANUFACTORY:
402 and 404 Greenwich Street, New
York City.

New England Office, 19 Pearl St., Boston.

Philadelphia Office, 301 Arch St.

Western Office, 139-141 Adams Street,
Chicago.

Southern Office, 25 Carondelet Street,
New Orleans.

"The Week, one of the ablest papers on the con-
tinent."—*Descriptive America*.

ENLARGED AND IMPROVED.

THE WEEK:

A Canadian Journal of Politics, Literature, Science
and Arts.

PUBLISHED EVERY FRIDAY.

\$3.00 per Year.

\$1.00 for Four Months.

THE WEEK has entered on its SIXTH year of publication, greatly enlarged and improved in every respect, rendering it still more worthy the cordial support of every one interested in the maintenance of a first-class literary journal.

The independence in politics and criticism which has characterized THE WEEK ever since its first issue will be rigidly maintained; and unceasing efforts will be made to improve its literary character and increase its value and attractiveness as a journal for the cultured home. Many new and able writers are now, or have promised to become, contributors to its columns, and the constant aim of the Publisher will be to make THE WEEK fully equal to the best literary journals in Britain and the United States.

As heretofore, PROF. GOLDWIN SMITH will, from time to time, contribute articles. London, Paris, Washington and Montreal letters from accomplished correspondents will appear at regular intervals. Special Ottawa Letters will appear during the sessions of Parliament.

THE WEEK in its enlarged form will be the same size as "Harpers' Weekly," and the largest paper of its class on the continent.

SEND FOR FREE SAMPLE COPY.

C. BLACKETT ROBINSON, Publisher,
5 Jordan St., Toronto.

A NEW MAGAZINE—THE SWISS CROSS

Devoted to spreading a love of nature among the people. Edited by HARLAN H. BALLARD, President of the Agassiz Association, and succeeding *St. Nicholas* as the official magazine of that body. \$1.50 a year. Sample copy 10 cents, or 25 cents for trial subscription for 3 months.

N. D. C. HODGES, PUBLISHER,
47 Lafayette Place, New York.

Wants.

A YOUNG MAN can have lucrative engagement, not only a fixed salary, but according to his work accomplished in travelling for SCIENCE. A personal interview invited.

N. D. C. HODGES,

47 Lafayette Place, New York.

MECHANICIAN.—An optician and maker of instruments of precision of experience would be glad of a position where his skill would be valued in connection with some higher educational institution. Address G. J., care of SCIENCE, 47 Lafayette Place, New York.

Scientific Apparatus.

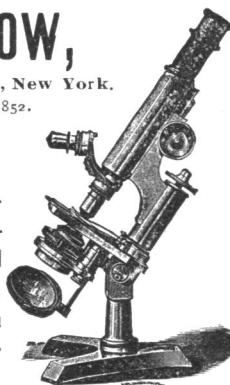
J. GRUNOW,

621 Sixth Avenue, New York.

Established 1852.

MAKER OF

Microscope Stands,
Oil Immersion Objectives and Abbe Condensers for Bacterial and Histological work, of Objectives, Camera Lucida and other accessory apparatus.



IMPROVED OIL LIGHT MAGIC LANTERNS.

Also Lime and Electric Light Apparatus, and mechanical, plain, and fine colored views.

J. B. COLT & CO., Manufacturers,
NO. 16 BECKMAN STREET, NEW YORK.

MAGIC LANTERNS Stereopticons and the Best Views for Public, Church, Home, and Scientific Exhibitions. Best apparatus, new views. Largest stock. Reduced prices. 24 Years' Practical Experience. Illus. Catalogue Free.

GEO. H. PIERCE,
136 S. Eleventh St., Philadelphia, Pa.

ELECTRICAL TESTING BUREAU,

Johns Hopkins University, Baltimore, Md.

Resistance Coils and Boxes Compared.
Am meters and Volt meters calibrated.
Condensers standardized.
Primary and Secondary Batteries Tested.
Efficiency of Dynamos and Motors Determined.
Insulation of Cables and Wires Tested.
Etc., Etc.
Circulars describing Methods Used, Prices, Etc., sent on Application.
Address as above.

MORRIS EARLE & CO.

SUCCESSORS TO

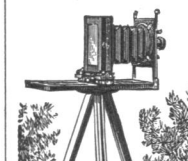
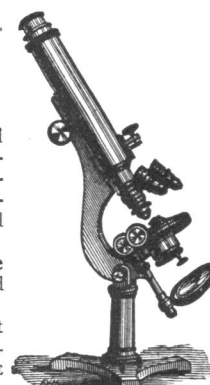
R. & J. BECK,

1016 Chestnut Street Phila

Microscopes and all Accessories and Apparatus. Photographic and Photo-Micrographic Apparatus and Outfits.

Spectacles, Eye Glasses, Opera and Marine Glasses, etc.

Illustrated Price List mailed free to any address. Mention SCIENCE in corresponding with us.



E. & H. T. ANTHONY & CO.
591 Broadway, N.Y.

Manufacturers and Importers of

PHOTOGRAPHIC INSTRUMENTS,

Apparatus and Supplies of every

description. Sole proprietors of

the Patent Detective, Fairy Nov-

el, and Bicycle Cameras, and the

Celebrated Stanley Dry Plates.

Amateur Outfits in great variety, from \$5.00 upward.

Send for Catalogue or call and examine. More than 40 years established in this line of business.



GOOD NEWS TO LADIES.

Greatest inducements ever offered. Now's your time to get up orders for our celebrated

Teas and Coffees, and secure

a beautiful Gold Band or Moss

Rose China Tea Set, Dinner Set,

Gold Band Moss Rose Toilet Set, Watch, Brass Lamp,

or Webster's Dictionary. For full particulars address

THE GREAT AMERICAN TEA CO.,
P. O. Box 289. 31 and 33 Vesey St., New York.

A TEMPORARY BINDER

for *Science* is now ready, and will be mailed postpaid on receipt of price.

Half Morocco - 75 cents.



This binder is strong, durable and elegant, has gilt side-title, and allows the opening of the pages perfectly flat. Any number can be taken out or replaced without disturbing the others, and the papers are not mutilated for subsequent permanent binding. Filed in this binder, *Science* is always convenient for reference.

N. D. C. HODGES,

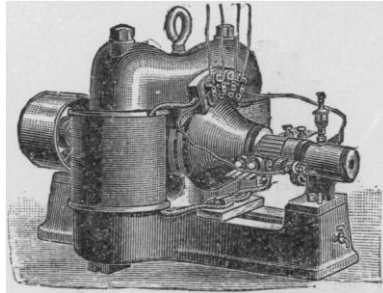
47 Lafayette Place, N. Y.

Readers of Science

Corresponding with or visiting Advertisers will confer a great favor by mentioning the paper.

Sprague Electric Railway and Motor Company.

For Stationary or Railway Work,
for Mining or Engineering
operations the SPRAGUE MOTORS
are unexcelled.



Estimates given for complete
Power Installations.

Send for Circulars and full
Information.

16 and 18 BROAD STREET, NEW YORK.

The Mutual Life Insurance Company OF NEW YORK.

RICHARD A. McCURDY, PRESIDENT.

ASSETS - - - \$126,082,153 56

The Largest and best Life Insurance Company in the World.

The New Business of the Mutual Life Insurance Company in 1888
Exceeded \$103,000,000.

Its Business shows the Greatest Comparative Gain made by
any Company during the past year including

A gain in assets of.....	\$ 7,275,301 68
A gain in income of.....	3,096,010 06
A gain in new premiums of.....	2,333,406 00
A gain in surplus of.....	1,645,622 11
A gain in new business of.....	33,756,792 85
A gain of risks in force.....	54,496,251 85

The Mutual Life Insurance Company

Has Paid to Policy-holders since Organization \$272,481,839 82.

PARIS EXPOSITION.

The Cheque Bank issues Cheques, either singly or put up in Books, for the special use of **VISITORS** to the **PARIS EXPOSITION**, who can cash the same at upwards of **seventy** Banking Houses, situated in different parts of Paris, **without charge**.

Visitors' mail matter can be addressed to them, Care of the Societe Generale, 4 Place de l'Opera, opposite the Grand Hotel, where English is spoken.

Every Cheque that is issued by the Cheque Bank is **EQUAL TO CASH**, as Bank Notes are, for the Bank's Capital, Guarantee Fund and Customers' Balances are invested in **British Government Securities**, or held in Cash in the **Bank of England**, and can be cashed in every town in Europe without charge.

For Handbook containing list of **2,500** Banking Houses who cash the cheques, *free of charge*, apply to

CHEQUE BANK, Limited,

Capital, £100,000. Guarantee Fund, £27,000.

Trustees, The Right Honorable John Bright, M.P., The Right Honorable Earl Beauchamp.

NO. 2 WALL STREET, NEW YORK.

Visitors to Europe and Paris Exposition should carry a book containing Cheque Bank Cheques, which are absolutely safe and cheaper than Letters of Credit, and much more convenient; are payable on presentation *without charge* at 2,500 Banking Houses and 250 of the principal Hotels in Europe.

Arnold, Constable & Co. INDIA PONGEES, CORAHS.

Great novelty of style and color is to be found in these fabrics. Unsurpassed for durability and wear. Late importations are now being opened.

Broadway & 19th st.

New York.

SOMETHING NEW
THE PATENT
ADJUSTABLE BRUSH.

LEPAGE'S
LIQUID GLUE
ALWAYS
READY FOR USE
MANUFACTURED BY
RUSSIA CEMENT CO.
GLOUCESTER, MASS. U.S.A.

Patent Pocket Can. No waste.

THE STRONGEST
GLUE
IN THE WORLD.
2 GOLD MEDALS
LONDON 1883 & NEW ORLEANS 1884.

RUSSIA CEMENT CO.
Gloucester, Mass.

Used by thousands of first-class mechanics and by such manufacturers as Pullman Palace Car Co., Mason & Hamlin Organ and Piano Co., &c., &c.

Repairs Everything.
Its success has brought a lot of imitators copying us in every way possible. Remember that THE ONLY GENUINE LePage's Liquid Glue is manufactured solely by the **RUSSIA CEMENT CO.** GLOUCESTER, MASS.

Send 10c. and dealers' card who doesn't keep it in stock, for sample.

FOOD ADULTERATION

And its Detection. With photomicrographic plates and a bibliographical appendix. By J. P. Battershall, 328 pages, 8vo, cloth. Price, \$3.50. Circulars and Catalogues on application. E. & F. N. SPON,

12 Cortlandt St., New York.

Readers of Science

Corresponding with or visiting Advertisers will confer a great favor by mentioning the paper.

Scott's
EMULSION

OF PURE
Cod-Liver
AND OIL
HYPOPHOSPHITES

ALMOST AS PALATABLE
AS MILK.

So disguised that the most delicate stomach can take it.

Remarkable as a
FLESH PRODUCER.
Persons gain rapidly
while taking it.

SCOTT'S EMULSION

Is acknowledged by Physicians to be the **FINEST** and **BEST** preparation of its class for the relief of
**CONSUMPTION, SCROFULA, GENERAL
DEBILITY, WASTING DISEASES OF
CHILDREN, and CHRONIC COUGHS.**

ALL DRUGGISTS. Scott & Bowne, New York.